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16. ABSTRACT Soil samples collected during the Direct/Delayed Response Project (DDRP) northeastern soil survey were analyzed, using the procedures described in the analytical methods manual for the DDRP (Cappoet al, 1986), by four different laboratories. Inconsistencies in results were reported by the different laboratories regardless of use of standardized procedures. Audit samples Oa, A, Bs, Bw, and C Horizons were included in this survey. The audit sample data were used for an interlaboratory comparison to determine if there are significant differences in the audit sample values reported by the laboratories. This analysis compares the laboratories to each other rather than to a true audit value. Such analysis has been completed for each chemistry variable in the DDRP northeast soil chemistry database. Various graphics display the results. Numerous significant interlaboratory differences were identified. The impact of significant interlaboratory value differences on data analyses is difficult to assess. If the samples from each sampling class, region, and state were uniformly distributed across all the laboratories, the interlaboratory value differences would likely have little effect on analyses conclusions. However, this is not the case. The significant value differences among laboratories are not consistent across all audit horizons, which makes it even more difficult to assess their effect on data analyses. The averaging that takes place during data aggregation will likely negate the effect of interlaboratory value differences. However, it is not possible to test this negation on a general scale.

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# INTERLABORATORY DIFFERENCES IN THE NORTHEASTERN SOIL SURVEY DATA

by

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## ABSTRACT

Soil samples collected during the Direct/Delayed Response Project (DDRP) northeastern soil survey were analyzed by four different laboratories. The laboratories were required to use the procedures described in the analytical methods manual for the DDRP soil survey (Cappo et al, 1986). Despite the use of standardized procedures, it is possible for laboratory biases to cause consistent differences in results reported by the different laboratories (Cronce and Ciolkosz 1985).

Audit samples from Oa, A, Bs, Bw and C horizons were included in the DDRP northeastern soil survey. The audit sample data were used for an interlaboratory comparison to determine if there are significant differences in the audit sample values reported by the laboratories. This analysis compares the laboratories to each other rather than to a true audit value. Such an analysis has been completed for each chemistry variable in the DDRP northeast soil chemistry data base. For each variable, the audit sample results are presented graphically, the significant interlaboratory differences are displayed in tabular form, and summary statistics of the DDRP routine sample results are provided to aid the reader in determining the practical importance of the observed differences.

Numerous significant interlaboratory differences were identified. The impact of significant interlaboratory value differences on data analyses is difficult to assess. If the samples from each sampling class, region, and state were uniformly distributed across all the laboratories, the interlaboratory value differences would likely have little effect on analyses conclusions. However, this is not the case. The significant value differences among laboratories are not consistent across all audit horizons, which makes it even more difficult to assess their effect on data analyses. The averaging that takes place during data aggregation will likely negate the effect of interlaboratory value

differences. However, it is not possible to test this negation on a general scale.

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# SECTION 1
# INTRODUCTION

The soil samples collected during the Direct/Delayed Response Project (DDRP) northeastern soil survey were analyzed by four different laboratories. The laboratories were required to use the procedures described in the analytical methods manual for the DDRP soil survey (Cappo et al, 1986). Despite the use of standardized procedures, it is possible for laboratory biases to cause consistent differences in results reported by the different laboratories (Cronce and Ciolkosz 1985).

Audit samples included in the DDRP northeastern soil survey can be used to evaluate the interlaboratory differences. Samples from Oa, A, Bs, Bw and C horizons were collected to form five corresponding master audit samples. Each master sample was homogenized and subsampled to provide individual audit samples. These audit samples were distributed to the preparation laboratories for submission with routine samples. The preparation laboratories grouped routine samples into batches to be sent to the analytical laboratories. Two audit samples from a common master audit sample were included with every batch.

To determine the laboratory bias, a true or accepted value is required for each master audit sample. This value is usually obtained from an independent laboratory or method considered to be accurate. Independent analyses were completed for the master samples in the DDRP northeastern soil survey, but procedural problems led to questionable results. Therefore, accepted values are not available for the soil survey audit samples; consequently, laboratory bias cannot be estimated.

The audit sample data can be used for an interlaboratory comparison to determine if there are significant differences in the audit sample values reported by the laboratories. This analysis compares the laboratories to each other rather than to a true audit value. Such an analysis has been completed for each chemistry variable in the DDRP

northeast soil chemistry data base, and the details of the analyses applied to the audit samples are provided. The results of the analyses are presented in Sect. 4. For each parameter, the audit sample results are presented graphically, the significant interlaboratory differences are displayed in tabular form, and summary statistics of the DDRP routine sample results are provided to aid the reader in determining the practical importance of the observed differences.

## SECTION 2
## CONCLUSIONS AND RECOMMENDATIONS

Numerous statistically significant interlaboratory value differences were found, however, only a few of these differences are large with respect to the variation observed in the routine data. Interlaboratory value differences that could cause problems in the analyses of routine sample data occurred for iron in 0.002 M $CaCl_2$, aluminum in citrate-dithionite, aluminum in 0.002 M $CaCl_2$, aluminum in KCl, calcium in 0.002 M $CaCl_2$, cation-exchange capacity in $NH_4Cl$, and very fine sand.

The impact of these interlaboratory differences on data analyses is difficult to assess. The soil survey design used the concept of sampling classes (EPA 1986). A sampling class is a group of soil series that, in theory, should be very similar. If the samples from each sampling class, region, and state were uniformly distributed across all the laboratories, the interlaboratory value differences would likely have little effect on analyses conclusions. However, this is not the case.

Many of the proposed levels of data evaluation require data aggregated to the sampling class level. This aggregation involves some type of averaging within sampling class and horizon combinations. This averaging will likely negate the effect of the interlaboratory value differences; however, this is very difficult to test on a general scale. The researchers using the DDRP data should be advised to include the appropriate caveats concerning interlaboratory value differences in the conclusions of their studies.

## SECTION 3
## METHODS

### AUDIT SAMPLE DATA PLOTS

A plot such as that displayed in Fig. 1 was prepared for each parameter. The plot is broken into five sections, each corresponding to a master audit sample from one of the five horizons (Oa, A, Bs, Bw, and C). Within each section, the data for that master audit sample are plotted against the analytical laboratory designation. Not every analytical laboratory received audit samples from each master sample; therefore, not all four laboratories appear in each section of the plot. Table 1 summarizes the number of batches with each audit sample type analyzed by each laboratory. Because each batch had two audit samples, the number of individual audit samples analyzed by each laboratory is twice that reported in Table 1.

Table 1. Number of batches with each audit sample type analyzed by each laboratory

| | Audit Horizon | | | | | |
|---|---|---|---|---|---|---|
| Laboratory | Oa | A | Bs | Bw | C | Total |
| 1 | 2 | 4 | 2 | 5 | 6 | 19 |
| 2 | 2 | 4 | 5 | 4 | 3 | 18 |
| 3 | | | 3 | 1 | | 4 |
| 4 | 2 | — | 5 | 3 | 5 | 15 |
| Total | 6 | 8 | 15 | 13 | 14 | 56 |

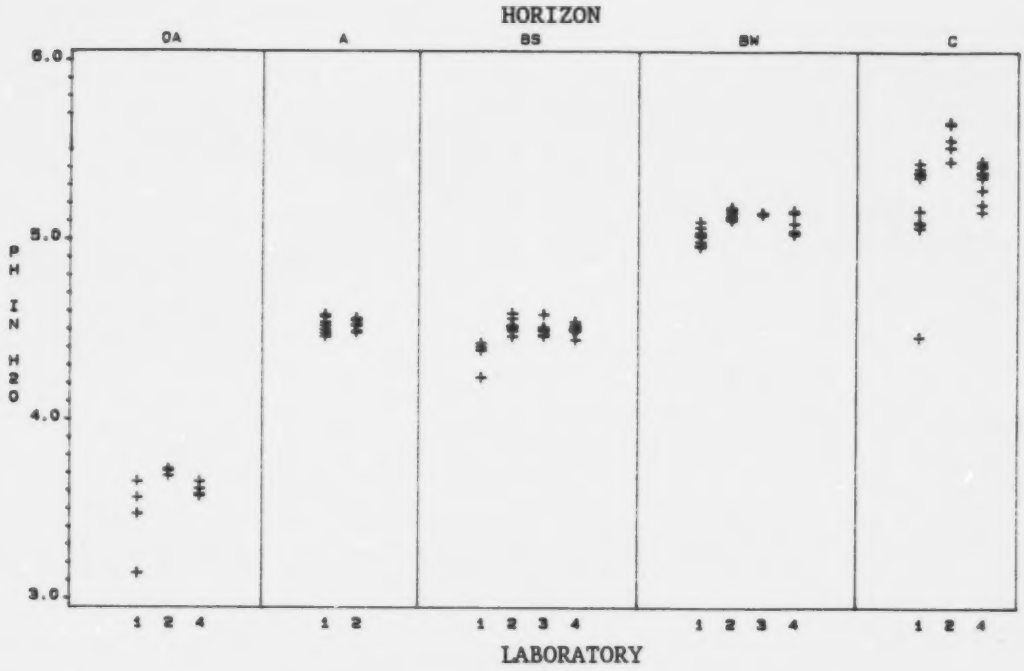


Figure 1. Audit sample data plot.

## LABORATORY COMPARISONS

The method of analysis of variance was used to determine significant differences among the audit sample values reported by the laboratories. Two factors, the master audit sample type and analytical laboratory, were considered. A preliminary review of the data indicated that, for many of the parameters, the variances were not equal across the master audit sample types. Because of this nonhomogeneity of variance and because not all master samples were analyzed by each laboratory, a separate, one-way analysis of variance with analytical laboratory as the factor was used for each master audit sample type. All significance tests were performed at the 0.05 significance level.

The preliminary review of the data also revealed that values from the two audit samples in the same batch tend to be very similar. This tendency for pairing is evident when the audit data are plotted against the batch number. Figure 2 illustrates the pairing observed in the Oa master sample pH in 0.002 M $CaCl_2$ data. This within-batch correlation violates the assumption of independent error terms required for a one-way analysis of variance. To eliminate this correlation, the mean of the audit sample pair within each batch was used for the analysis of variance. The following one-way analysis of variance model was used.

$$\bar{Y}_{ij\cdot} = \mu + L_i + e_{ij} ,$$

where $\bar{Y}_{ij\cdot}$ is the mean of the two audit samples in the jth batch,
$\mu$ is a constant component of all observations,
$L_i$ is the effect of the ith laboratory, and
$e_{ij}$ is the random error term.

For testing differences among values reported by the laboratories, the above model is equivalent to a repeated-measures model where batch is the experimental unit (SAS 1985).

When the analysis of variance indicates significant differences among values reported by the laboratories, it is important to identify what those differences are. The Scheffe multiple-comparison procedure (Neter & Wasserman 1974) was used for all pairwise comparisons of values

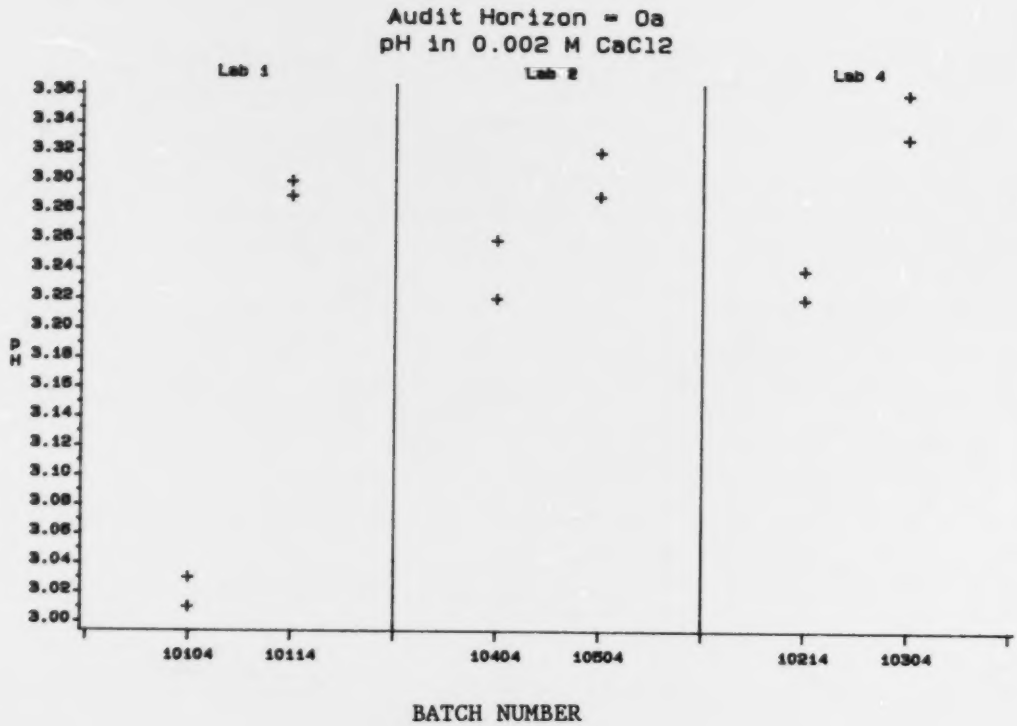


Figure 2. pH in 0.002 M $CaCl_2$ results for Oa horizon audit sample pairs within sample batches.

reported by the laboratories. With this procedure, a significance level of 0.05 is maintained for the entire set of comparisons. With the Scheffe procedure, it is not necessary to have the same number of audit samples for each laboratory.

For each parameter, the results of the laboratory comparisons are summarized as in Table 2. The mean values for all analytical laboratory and master sample combinations are presented. The differences found to be statistically significant by the Scheffe procedure are identified; for example, in the Bs master sample, the value reported by laboratory 1 is significantly lower than those of the other three laboratories. For each horizon, the maximum difference among laboratory means is included in the table to assist the reader in evaluating the practical importance of the significant differences.

Table 2. Summary of laboratory comparison analysis

| | Parameter = PH_H2O Means by laboratory | | | | Laboratories that differ significantly | Maximum difference among laboratory |
|---|---|---|---|---|---|---|
| Horizon | 1 | 2 | 3 | 4 | (0.05 significance level) | means |
| Oa | 3.46 | 3.71 | | 3.60 | None | 0.25 |
| A | 4.53 | 4.52 | | | None | 0.01 |
| Bs | 4.36 | 4.52 | 4.50 | 4.50 | 1 < 2,3,4 | 0.16 |
| Bw | 5.02 | 5.14 | 5.15 | 5.09 | 1 < 2 | 0.12 |
| C | 5.19 | 5.56 | | 5.34 | 1 < 2 | 0.38 |

Audit sample ANOVA summary
Ho: No differences among laboratories' reported values

| Horizon | Error DF | Standard deviation | Significance level |
|---|---|---|---|
| Oa | 3 | 0.125 | 0.277 |
| A | 6 | 0.032 | 0.794 |
| Bs | 11 | 0.032 | 0.001 |
| Bw | 9 | 0.040 | 0.010 |
| C | 11 | 0.173 | 0.031 |

The analysis of variance statistics for each master sample are also included in Table 2. The null hypothesis tested in the analysis of

variance (ANOVA) is "$H_0$: No differences among analytical laboratories." The summary table includes the degrees of freedom (DF) for the error term, the standard deviation of the dependent variable estimated by the root mean square error, and the significance level of the test. Very small values for significance level (less than 0.05) imply a significant difference among the values reported by the analytical laboratories.

## EVALUATION OF STATISTICALLY SIGNIFICANT DIFFERENCES

The statistically significant differences among values reported by the laboratories may or may not be of practical importance to the data user. These significant differences were determined relative to the within-laboratory variation observed in the audit samples. If the variation in the audit samples was smaller than the variation observed in routine samples, the interlaboratory differences may have little impact on the conclusions derived from the soils data.

The soil survey design used the concept of sampling classes (EPA 1986). A sampling class is a group of soil series that, in theory, should be very similar. Many of the proposed levels of data evaluation require data aggregated to the sampling class level. This aggregation involves some type of averaging within sampling class and horizon combinations. Therefore, samples from the same sampling class and same horizon were treated as one group. Estimates of the variability observed within these groups should be helpful in determining which significant laboratory differences are important.

Statistical testing using estimates from the routine sample data would require the development of statistical models that are beyond the scope of this report. However, a review of the interlaboratory value differences relative to simple estimates of the within-sampling-class variation can be useful to the data user. Because of the manner in which sampling classes were defined, it is possible that a few sampling classes will have large variability. A study to evaluate the within- and between-sampling-class variation is being conducted, but results are not yet available. Therefore, for the purposes of this report, an estimator of within-sampling-class variation, which is robust to a few possible

outliers, is desirable. The median value of the within-sampling-class standard deviations was selected. This estimate was obtained by first calculating the standard deviation for each sampling class and then selecting the median of those values. Estimates were obtained for routine data with horizon masters O, A, and C; and for Bs and Bw horizon masters.

The observed interlaboratory differences were compared with the within-sampling-class standard deviation estimates. If the interlaboratory differences were large, relative to the routine data variation, they could affect inferences based on the routine data and should be considered when interpreting the results of data analyses.

For each parameter, the comparison of interlaboratory value differences with the routine data statistics is summarized as in Table 3. The "Routine data within-sampling-class standard deviation" is the median value of the within-sampling-class standard deviations, as defined above. For each master audit sample, the maximum difference between laboratory means was calculated. This difference was then divided by the within-sampling-class standard deviation, and the resulting value is displayed in Table 3. As noted above, a formal statistical test with this statistic is beyond the scope of this report and, therefore, a critical value associated with a selected significance level is not available. However, it is reasonable to assume that interlaboratory value differences greater than two times the routine data standard deviation are important to the data user.

The impact of "important" interlaboratory value differences on data analyses is difficult to assess. If the samples from each sampling class, region, and state were uniformly distributed across all the laboratories, the interlaboratory value differences would likely have little effect on analyses conclusions. However, this is not the case. Tables 4, 5, and 6 contain the number of samples analyzed by each laboratory, listed by sampling class, region, and state, respectively. The nonuniformity of samples across laboratories is especially obvious in Table 6, where, for example, laboratory 4 analyzed all the samples for Connecticut and Rhode Island.

The significant value differences among laboratories are usually not

consistent across all audit horizons, which makes it even more difficult to assess their effect on data analyses. Table 7 displays the number of routine samples analyzed by each laboratory, listed by soil horizon.

The averaging that takes place during data aggregation will likely negate the effect of many interlaboratory value differences. However, it is not possible to test this negation on a general scale. The researchers using the DDRP data should be advised to include the appropriate caveats concerning interlaboratory value differences in the conclusions of their studies.

Table 3. Summary of the comparison of interlaboratory value differences with routine data variation

| Horizon | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|
| Oa | 0.395 | 0.63 |
| A | 0.462 | 0.01 |
| Bs | 0.288 | 0.56 |
| Bw | 0.290 | 0.42 |
| C | 0.427 | 0.89 |

Table 4. Number and percentage of routine samples from each sampling class analyzed by each laboratory

| Sampling class | Laboratory 1 (No.) | 1 (%) | 2 (No.) | 2 (%) | 3 (No.) | 3 (%) | 4 (No.) | 4 (%) | Total |
|---|---|---|---|---|---|---|---|---|---|
| E02 | 21 | 51.2 | 16 | 39.0 | | | 4 | 9.8 | 41 |
| E03 | | | 14 | 24.1 | | | 44 | 75.9 | 58 |
| E05 | 4 | 28.6 | 10 | 71.4 | | | | | 14 |
| E06 | 3 | 14.3 | 12 | 57.1 | | | 6 | 28.6 | 21 |
| H01 | 3 | 25.0 | 5 | 41.7 | 2 | 16.7 | 2 | 16.7 | 12 |
| H02 | 3 | 10.3 | | | 9 | 31.0 | 17 | 58.6 | 29 |
| H03 | 11 | 39.3 | 13 | 46.4 | | | 4 | 14.3 | 28 |
| I01 | 15 | 35.7 | 24 | 57.1 | | | 3 | 7.1 | 42 |
| I02 | 26 | 61.9 | 12 | 28.6 | | | 4 | 9.5 | 42 |
| I05 | | | 8 | 22.2 | 5 | 13.9 | 23 | 63.9 | 36 |
| I06 | 2 | 7.7 | 6 | 23.1 | | | 18 | 69.2 | 26 |
| I09 | 10 | 21.3 | 10 | 21.3 | 11 | 23.4 | 16 | 34.0 | 47 |
| I10 | | | | | | | 49 | 100.0 | 49 |
| I11 | 8 | 14.3 | 11 | 19.6 | | | 37 | 66.1 | 56 |
| I21 | | | | | | | 11 | 100.0 | 11 |
| I25 | 26 | 53.1 | 23 | 46.9 | | | | | 49 |
| I29 | 28 | 75.7 | 6 | 16.2 | 3 | 8.1 | | | 37 |
| I30 | 8 | 47.1 | 9 | 52.9 | | | | | 17 |
| I33 | 42 | 76.4 | 6 | 10.9 | 7 | 12.7 | | | 55 |
| I37 | 9 | 20.0 | 12 | 26.7 | | | 24 | 53.3 | 45 |
| I38 | 14 | 48.3 | 4 | 13.8 | | | 11 | 37.9 | 29 |
| I40 | 19 | 34.6 | 20 | 36.4 | 5 | 9.1 | 11 | 20.0 | 55 |
| I41 | 11 | 23.9 | 7 | 15.2 | | | 28 | 60.9 | 46 |
| I42 | 6 | 14.6 | 29 | 70.7 | | | 6 | 14.6 | 41 |
| I46 | 27 | 64.3 | 15 | 35.7 | | | | | 42 |
| S01 | 28 | 45.2 | 15 | 24.2 | 6 | 9.7 | 13 | 21.0 | 62 |
| S02 | 13 | 22.4 | 34 | 58.6 | 4 | 6.9 | 7 | 12.1 | 58 |
| S05 | | | 30 | 100.0 | | | | | 30 |
| S09 | 24 | 48.0 | 19 | 38.0 | | | 7 | 14.0 | 50 |
| S10 | 27 | 50.9 | 20 | 37.7 | | | 6 | 11.3 | 53 |
| S11 | 12 | 27.3 | 15 | 34.1 | | | 17 | 38.6 | 44 |
| S12 | 9 | 28.1 | 10 | 31.3 | | | 13 | 40.1 | 32 |
| S13 | 20 | 64.5 | 11 | 35.5 | | | | | 31 |
| S14 | 12 | 24.0 | 30 | 60.0 | | | 8 | 16.0 | 50 |
| S15 | 27 | 69.2 | 12 | 30.8 | | | | | 39 |
| S16 | 33 | 67.4 | 16 | 32.7 | | | | | 49 |
| S17 | 25 | 100.0 | | | | | | | 25 |
| S18 | 18 | 72.0 | 7 | 28.0 | | | | | 25 |
| TOTAL | 544 | | 491 | | 52 | | 389 | | 1476 |

Table 5. Number and percentage of routine samples from each region analyzed by each laboratory

| Region | Laboratory 1 (No.) | 1 (%) | 2 (No.) | 2 (%) | 3 (No.) | 3 (%) | 4 (No.) | 4 (%) | Total |
|---|---|---|---|---|---|---|---|---|---|
| Adirondacks | 47 | 15.9 | 217 | 73.3 | 17 | 5.7 | 15 | 5.1 | 296 |
| Poconos/ Catskills | 118 | 50.0 | 54 | 22.9 | 30 | 12.7 | 34 | 14.4 | 236 |
| Central New England | 134 | 45.3 | 32 | 10.8 | | | 130 | 43.9 | 296 |
| Southern New England | 36 | 10.8 | 84 | 25.1 | 5 | 1.5 | 210 | 62.7 | 335 |
| Maine | 209 | 66.8 | 104 | 33.2 | | | | | 313 |
| TOTAL | 544 | | 491 | | 52 | | 389 | | 1476 |

Table 6. Number and percentage of routine samples from each state analyzed by each laboratory

| State | Laboratory 1 (No.) | 1 (%) | 2 (No.) | 2 (%) | 3 (No.) | 3 (%) | 4 (No.) | 4 (%) | Total |
|---|---|---|---|---|---|---|---|---|---|
| Conn. | | | | | | | 60 | 100.0 | 60 |
| Mass. | 58 | 20.3 | 99 | 34.6 | | | 129 | 45.1 | 286 |
| Maine | 282 | 70.0 | 121 | 30.0 | | | | | 403 |
| N.H. | 30 | 20.1 | | | | | 119 | 79.9 | 149 |
| N.Y. | 52 | 13.8 | 247 | 65.7 | 52 | 13.8 | 25 | 6.7 | 376 |
| Pa. | 113 | 82.5 | 24 | 82.5 | | | | | 137 |
| R.I. | | | | | | | 56 | 100.0 | 56 |
| Vt. | 9 | 100.0 | | | | | | | 9 |
| TOTAL | 544 | | 491 | | 52 | | 389 | | 1476 |

Table 7. Number and percentage of routine samples from each horizon master analyzed by each laboratory

| Horizon Master | Laboratory 1 (No.) | 1 (%) | 2 (No.) | 2 (%) | 3 (No.) | 3 (%) | 4 (No.) | 4 (%) | Total |
|---|---|---|---|---|---|---|---|---|---|
| O | 86 | 34.0 | 86 | 34.0 | 11 | 4.4 | 70 | 27.7 | 253 |
| A | 48 | 36.1 | 45 | 33.8 | 7 | 5.3 | 33 | 24.8 | 133 |
| E | 35 | 50.0 | 22 | 31.4 | 1 | 1.4 | 12 | 17.1 | 70 |
| B | 220 | 37.9 | 190 | 32.8 | 17 | 2.9 | 153 | 26.4 | 580 |
| BC | 25 | 47.2 | 23 | 43.4 | 1 | 1.9 | 4 | 7.6 | 53 |
| C | 130 | 33.6 | 125 | 32.3 | 15 | 3.9 | 117 | 30.2 | 387 |
| TOTAL | 544 | | 491 | | 52 | | 389 | | 1476 |

## SECTION 4
## RESULTS

This section contains the results of the analyses completed for each parameter in the DDRP northeast soil chemistry data base. The results are organized according to the following parameter groups:

1. pH,
2. acidity,
3. sulfate isotherms,
4. iron,
5. aluminum,
6. cations in $CaCl_2$,
7. cations in $NH_4Cl$,
8. cations in $NH_4OAc$,
9. sulfate,
10. carbon, nitrogen, and sulfur,
11. particle size, and
12. moisture and specific surface.

A brief discussion of the audit sample data is presented for each group, and the following information is provided for each parameter: (1) a plot of the audit sample data, (2) the audit sample means for each laboratory, with identification of statistically significant value differences, (3) the audit sample analysis-of-variance statistics, and (4) routine sample statistics to aid in evaluating laboratory value differences.

Although many statistically significant interlaboratory value differences were found, only a few of these differences are large with respect to the variation observed in the routine data. Interlaboratory value differences that could cause problems in the analyses of routine sample data occurred for iron in 0.002 M $CaCl_2$, aluminum in citrate-dithionite, aluminum in 0.002 M $CaCl_2$, aluminum in KCl, calcium in 0.002

M $CaCl_2$, cation-exchange capacity in $NH_4Cl$, and very fine sand.

pH

Three measures of pH are included in the DDRP data base: pH in $H_2O$, in 0.002 M $CaCl_2$ and in 0.01 M $CaCl_2$. The results of the analyses for these parameters are presented in Appendix A, Figs. A.1 through A.3, respectively. The Bs, Bw, and C audit horizons were found to have significant interlaboratory value differences for pH in $H_2O$, with laboratory 1 reporting low values. No significant interlaboratory value differences were found for pH in 0.002 M $CaCl_2$. The A horizon had significant interlaboratory value differences for pH in 0.01 M $CaCl_2$, with laboratory 2 reporting lower values than laboratory 1. Although the above interlaboratory value differences were found to be statistically significant, they are small compared to the variation observed in the routine data. It is unlikely that they will affect the DDRP data analysis conclusions.

ACIDITY

Two acidity measures are included in the DDRP data base: acidity exchangeable in $BaCl_2$ and acidity in KCl. The results of the analyses for these parameters are presented in Appendix A, Figs. A.4 and A.5. No significant interlaboratory value differences were found for acidity in $BaCl_2$. Significant value differences among laboratories were found in the A and Bs audit horizons for acidity in KCl. Laboratory 1 values are lower than laboratory 2 values in A horizon, and laboratory 3 values are lower than laboratory 4 values in the Bs horizon. Because these interlaboratory value differences are not consistent across all the audit horizons and because they are small, relative to routine data variation, it is unlikely that they will affect the data analysis conclusions.

SULFATE ISOTHERMS

The DDRP data base contains data for six sulfate isotherm

parameters. The final solution-sulfate concentrations are reported for solutions with initial sulfur concentrations of approximately 0, 2, 4, 8, 16, and 32 mg/L. The results of the analyses for these parameters are presented in Appendix A, Figs. A.6 through A.11. No significant interlaboratory value differences were found for solutions with initial sulfur concentrations of 0 or 32 mg/L. Significant interlaboratory value differences were found in the Oa horizon for solutions with initial sulfur concentrations of 2, 4 or 16 mg/L; in the A horizon for solutions with 4 or 8 mg/L; and in the Bw horizon for solutions with 8 mg/L. In general, laboratory 4 tended to report low values in the Oa horizon and laboratory 1 reported lower values than laboratory 2 in the A horizon. These significant interlaboratory value differences are small, compared with the variation observed in the routine data.

The DDRP data base also includes a calculated value for net sulfate adsorbed by the soil for each sulfate isotherm parameter. The results of the analyses for the net sulfate adsorbed parameters are presented in Appendix A, Figs. A.12 through A.17. No significant interlaboratory value differences were found for solutions with no initial concentration of sulfur. Significant interlaboratory value differences were found in the Oa horizon for solutions with initial sulfur concentrations of 2, 4, or 16 mg/L; in the A horizon for solutions with 2, 4, or 8 mg/L; in the Bs horizon for solutions with 32 mg/L; and in the C horizon for solutions with 2 or 4 mg S/L. In general, laboratory 4 reported higher net adsorbed sulfate in the Oa and C horizons, and laboratory 1 reported higher net adsorbed sulfate than laboratory 2 in the A horizon. These significant differences are small, relative to the variation observed in the routine data.

## IRON

The DDRP data base contains parameters for iron measured in four different extracts: acid-oxalate, citrate-dithionite, 0.002 M $CaCl_2$, and pyrophosphate. The results of the analyses for these parameters are presented in Appendix A, Figs. A.18 through A.21. Significant interlaboratory value differences were found in the A horizon for the

acid-oxalate extractable iron, in the Bs horizon for the iron in $CaCl_2$, and in the Bw horizon for citrate-dithionite extractable iron. No significant interlaboratory value differences were found for iron extractable in pyrophosphate. The only significant value differences that are large, relative to routine data variation, occur in the Bs horizon for iron in 0.002 M $CaCl_2$. In that horizon, laboratory 2 reported values that are higher than those reported by the other laboratories.

## ALUMINUM

The DDRP data base contains parameters for aluminum measured in five different extracts: acid-oxalate, citrate-dithionite, 0.002 M $CaCl_2$, KCl, and pyrophosphate. The results of the analyses for these parameters are presented in Appendix A, Figs. A.22 through A.26. Significant interlaboratory value differences were found in the A and Bs horizons for the acid-oxalate extractable aluminum; in the Bw horizon for aluminum extractable in citrate-dithionite; in the Oa and Bs horizons for aluminum in $CaCl_2$; and in the Oa, A, Bw, and C horizons for KCl aluminum. No significant interlaboratory value differences were found for aluminum extractable in pyrophosphate. The significant value differences among laboratories vary for the different aluminum extracts and horizons (see Appendix A, Figs. A.22 through A.26), however; in many cases, laboratory 1 tended to report values lower than those reported by other laboratories. The significant value differences that are large, relative to routine data variation, occur in the Bw horizon for aluminum in citrate-dithionite, in the Oa and Bs horizons for aluminum in 0.002 M $CaCl_2$, and in the Oa horizon for aluminum in KCl.

## CATIONS IN $CaCl_2$

The DDRP data base contains measurements of calcium, magnesium, potassium, and sodium exchangeable in 0.002 M $CaCl_2$. The results of the analyses for these parameters are presented in Appendix A, Figs.

A.27 through A.30. Significant interlaboratory value differences were found in the Oa horizon for calcium and potassium; in the Bs horizon for calcium, magnesium, potassium, and sodium; in the Bw horizon for calcium and magnesium; and in the C horizon for calcium and potassium. In general, for the Oa horizon, laboratory 1 tended to report values lower than those reported by laboratories 2 and 4; for the Bs and Bw horizons, laboratories 1 and 3 reported values lower than those reported by laboratories 2 and 4; and for the C horizon, laboratory 1 reported values lower than those reported by laboratories 2 and 4. The only significant value differences that are large, relative to routine data variation, occur for calcium. The interlaboratory value differences observed for calcium in the Oa, Bw, and C horizon exceed two times the estimated routine data standard deviation.

CATIONS IN $NH_4Cl$

The DDRP data base contains measurements of calcium, magnesium, potassium, sodium, and cation-exchange capacity (CEC) exchangeable in $NH_4Cl$. The results of the analyses for these parameters are presented in Appendix A, Figs. A.31 through A.35. Significant interlaboratory value differences were found in the Oa horizon for magnesium; in the A horizon for calcium, sodium, and CEC; and in the Bs and Bw horizons for CEC. For magnesium in the Oa horizon, laboratory 1 reported values lower than those reported by laboratory 4; for calcium, sodium, and CEC in the A horizon, laboratory 2 reported values lower than those reported by laboratory 1; and for CEC in the Bs and Bw horizons, laboratories 1, 2, and 4 reported values lower than those reported by laboratory 3. The only statistically significant value difference for this parameter group that is large, relative to routine data variation, is for CEC in the Bw horizon.

CATIONS IN $NH_4OAc$

The DDRP data base contains measurements of calcium, magnesium, potassium, sodium, and cation-exchange capacity (CEC) exchangeable in

$NH_4OAc$. The results of the analyses for these parameters are presented in Appendix A, Figs. A.36 through A.40. Significant interlaboratory value differences were found in the A horizon for potassium and CEC, in the Bs horizon for magnesium and potassium, in the Bw horizon for CEC, and in the C horizon for CEC. The significant value differences between laboratories vary for the different cations and horizons (see Appendix A, Figs. A.36 through A.40). None of the statistically significant differences for this parameter group are large relative to routine data variation.

## SULFATE

The DDRP data base contains parameters for sulfate extractable in $H_2O$ and sulfate extractable in $Na_2PO_4$. The results of the analyses for these parameters are presented in Appendix A, Figs. A.41 and A.42. No significant interlaboratory value differences were found for sulfate extractable in $H_2O$. For sulfate extractable in $PO_4$, laboratory 4 reported values lower than those reported by laboratory 1 in the C horizon; this value was the only significant difference found for this parameter group, and it is not large, relative to the routine data variation.

## TOTAL CARBON, TOTAL NITROGEN, AND TOTAL SULFUR

The DDRP data base contains measurements of total carbon, total nitrogen, and total sulfur. The results of the analyses for these parameters are presented in Appendix A, Figs. A.43 through A.45. Significant interlaboratory value differences were found in the Oa and Bs horizons for all three parameters. No other significant interlaboratory value differences were found. In the Oa horizon, laboratory 1 reported carbon and nitrogen values lower than those reported by laboratories 2 and 4, and laboratory 4 reported sulfur values lower than those reported by laboratories 1 and 2. In the Bs horizon, laboratory 1 reported carbon, nitrogen, and sulfur values higher than those reported by the

other laboratories. None of the significant interlaboratory values differences for this parameter group are large relative to routine data variation.

## PARTICLE SIZE

The DDRP data base contains ten particle-size parameters: total sand, total silt, total clay, very coarse sand, coarse sand, medium sand, fine sand, very fine sand, coarse silt, and fine silt. The results of the analyses for these parameters are presented in Appendix A, Figs A.46 through A.55. Significant interlaboratory value differences were found in the A horizon for total sand, total silt, medium sand, fine sand, very fine sand, coarse sand, and fine silt; in the Bs horizon for total clay and medium sand; in the Bw horizon for total sand, total silt, very fine sand, and coarse silt; and in the C horizon for medium sand. In the Oa horizon, laboratory 1 tended to report sand values lower than those reported by laboratory 2, but reported silt values higher than those reported by laboratory 2. In the Bs, Bw, and C horizons, laboratory 2 tended to report values different from the other laboratories but, for some parameters, laboratory 2 reported values were high and, for other parameters, laboratory 2 reported values were low. The differences are inconsistent because the particle-size measurements are not independent and are constrained by the requirement that total sand, silt, and clay sum to 100%. The only significant interlaboratory value difference that is large, relative to routine data variation, occurs for very fine sand in the Bw horizon.

## MOISTURE AND SPECIFIC SURFACE

The DDRP data base contains measurements of air dry moisture and specific surface. The results of the analyses for these parameters are presented in Appendix A, Figs. A.56 and A.57. Significant interlaboratory value differences were found for moisture in the Bs and Bw horizons and for specific surface in the Bs and C horizons. The

significant value differences among laboratories vary in the different horizons for both parameters (see Appendix A, Figs. A.56 and A.57). None of the statistically significant value differences for this parameter group are large, relative to routine data variation.

## SECTION 5

## SUMMARY OF SIGNIFICANT INTERLABORATORY VALUE DIFFERENCES

The statistically significant interlaboratory value differences identified by the analyses described in Sect. 4 are summarized in Table 8. In this summary table, the parameters are identified by the DDRP data base variable name, and they are presented in the same order as in Sect. 4. The significant interlaboratory value differences are expressed as inequalities between laboratory designators. For example, $1 < 2$ for pH in water in the C horizon indicates that laboratory 1 reported values significantly lower than those reported by laboratory 2. In this example, the values reported by laboratory 4 were not significantly different from those reported by either laboratory 1 or laboratory 2. Significant value differences that are larger than two times the estimated routine data standard deviations are denoted by asterisks in Table 8. These asterisked differences should be considered by the data users when interpreting data analysis results.

Table 8. Summary of statistically significant interlaboratory value differences

| Parameter | Master Audit Horizon | | | | |
|---|---|---|---|---|---|
| | Oa | A | Bs | Bw | C |
| PH_H2O | | | 1 < 2,3,4 | 1 < 2 | 1 < 2 |
| PH_002M | | | | | |
| PH_01M | | 2 < 1 | | | |
| AC_BACL | | | | | |
| AC_KCL | | 1 < 2 | 3 < 4 | | |
| SO4_0 | | | | | |
| SO4_2 | 4 < 1,2 | | | | |
| SO4_4 | 4 < 1 | 1 < 2 | | | |
| SO4_8 | | 1 < 2 | | 4 < 1,2,3 | |
| SO4_16 | 2,4 < 1 | | | | |
| SO4_32 | | | | | |
| SO4_0N | | | | | |
| SO4_2N | 1,2 < 4 | 2 < 1 | | | 1 < 4 |
| SO4_4N | 1 < 4 | 2 < 1 | | | 1 < 4 |
| SO4_8N | | 2 < 1 | | | |
| SO4_16N | 1 < 4<br>4 < 2 | | | | |
| SO4_32N | | | 1 < 2,4<br>3 < 4 | | |
| FE_AO | | 1 < 2 | | | |
| FE_CD | | | | 2 < 3 | |
| FE_CL2 | | | * 1,3,4 < 2 * | | |
| FE_PYP | | | | | |
| AL_AO | | 1 < 2 | 1,3,4 < 2 | | |
| AL_CD | | | | * 1 < 3 * | |
| AL_CL2 | * 1 < 4 * | | * 1 < 2,4 *<br>* 3 < 4 * | | |
| AL_KCL | * 1,2 < 4 * | 1 < 2 | | 2 < 1,3,4<br>1 < 4 | 1 < 4 |
| AL_PYP | | | | | |

(continued)

Table 8 (continued). Summary of statistically significant interlaboratory value differences

| Parameter | Master Audit Horizon Oa | A | Bs | Bw | C |
|---|---|---|---|---|---|
| CA_CL2 | * 1 < 2,4 * | | 1,3 < 2,4 | * 1,3 < 2,4 * | * 1 < 2,4 * |
| MG_CL2 | | | 3 < 2 | 1 < 2 | |
| K_CL2 | 1 < 4 | | 3,4 < 2 | | 1 < 4 |
| NA_CL2 | | | 3 < 4 | | |
| CA_CL | | 2 < 1 | | | |
| MG_CL | 1 < 4 | | | | |
| K_CL | | | | | |
| NA_CL | | 2 < 1 | | | |
| CEC_CL | | 2 < 1 | 1,2,4 < 3 | * 2,4 < 1 * | |
| | | | | * 1 < 3 * | |
| CA_OAC | | | | | |
| MG_OAC | | | 2 < 1 | | |
| K_OAC | | 2 < 1 | 1,2,4 < 3 | | |
| NA_OAC | | | | | |
| CEC_OAC | | 2 < 1 | | 2 < 1,3 | 2,4 < 1 |
| | | | | 4 < 3 | |
| SO4_H2O | | | | | |
| SO4_PO4 | | | | | 4 < 1 |
| C_TOT | 1 < 2,4 | | 2,3,4 < 1 | | |
| N_TOT | 1 < 4 | | 2,3,4 < 1 | | |
| S_TOT | 4 < 1,2 | | 2,3,4 < 1 | | |
| SAND | | 1 < 2 | | 1,3,4 < 2 | |
| | | | | 1 < 4 | |
| SILT | | 2 < 1 | | 2 < 3,4 | |
| | | | | 3,4 < 1 | |
| CLAY | | | 1,3,4 < 2 | | |
| VCOS_SS | | | | | |
| COS_SS | | | | | |
| MS_SS | | 1 < 2 | 1 < 4 | | 2 < 4 |
| | | | 2 < 3,4 | | |
| FS_SS | | 1 < 2 | | | |
| VFS_SS | | 1 < 2 | | * 1,3,4 < 2 * | |
| | | | | * 1 < 4 * | |
| COSI_SS | | 2 < 1 | | 2 < 1,3,4 | |
| FSI_SS | | 2 < 1 | | | |
| MOIST | | | 3 < 4 | 1 < 2,4 | |
| SP_SUR | | | 1 < 3 | | 1 < 4 |

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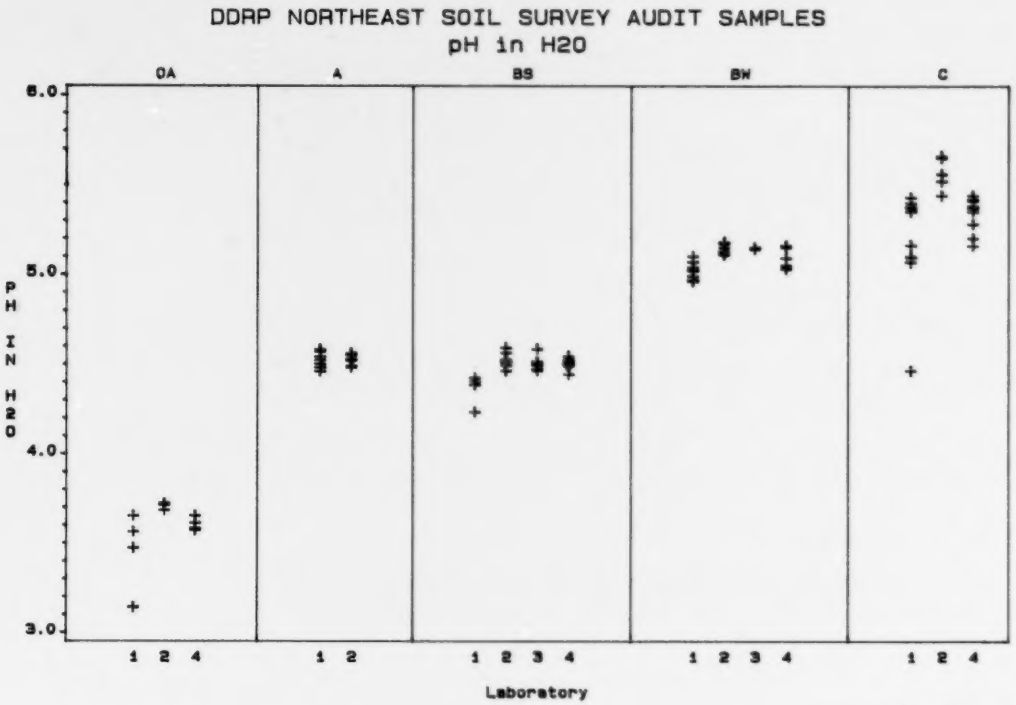
# APPENDIX A

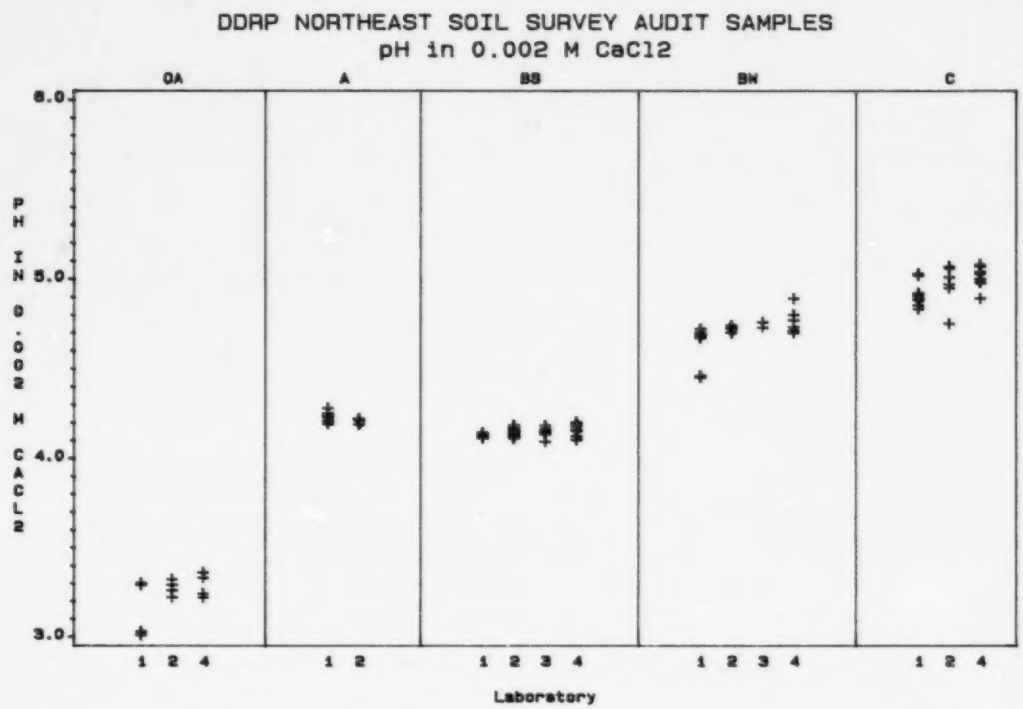
## ANALYSIS RESULT SUMMARY




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 3.46 | 3.71 | | 3.60 | None | 0.25 |
| A | 4.53 | 4.52 | | | None | 0.01 |
| Bs | 4.36 | 4.52 | 4.50 | 4.50 | 1 < 2,3,4 | 0.16 |
| Bw | 5.02 | 5.14 | 5.15 | 5.09 | 1 < 2 | 0.12 |
| C | 5.19 | 5.56 | | 5.34 | 1 < 2 | 0.38 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values — Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.125 | 0.277 | 0.395 | 0.63 |
| A | 6 | 0.032 | 0.794 | 0.462 | 0.01 |
| Bs | 11 | 0.032 | 0.001 | 0.288 | 0.56 |
| Bw | 9 | 0.040 | 0.010 | 0.290 | 0.42 |
| C | 11 | 0.173 | 0.031 | 0.427 | 0.89 |

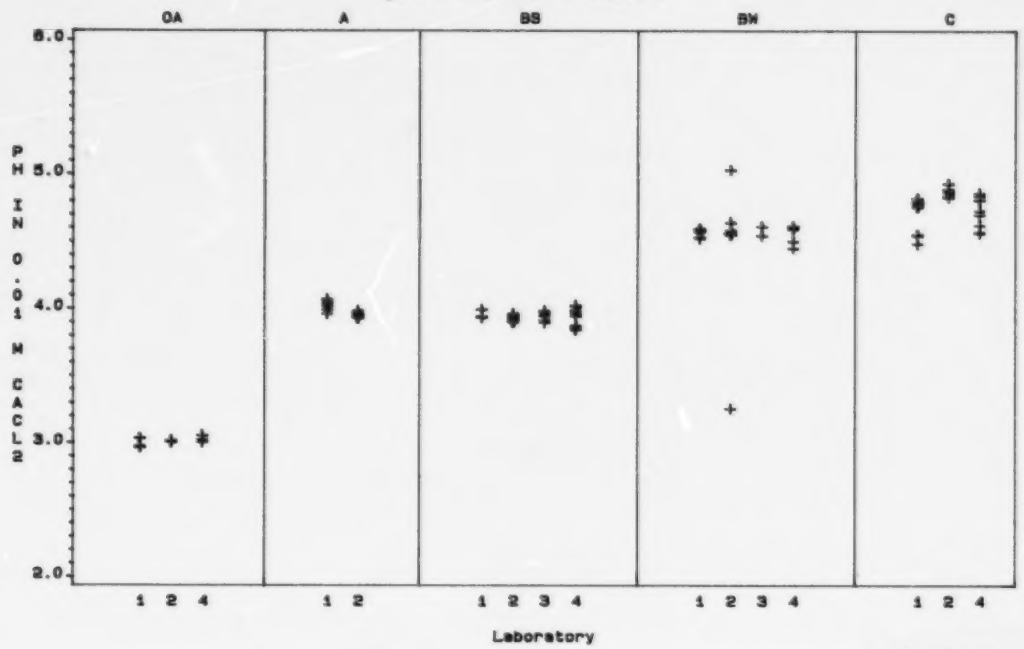
Figure A.1. Interlaboratory difference analysis of pH in $H_2O$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 3.16 | 3.27 | | 3.29 | None | 0.13 |
| A | 4.23 | 4.21 | | | None | 0.02 |
| Bs | 4.13 | 4.14 | 4.14 | 4.15 | None | 0.03 |
| Bw | 4.65 | 4.72 | 4.75 | 4.77 | None | 0.12 |
| C | 4.91 | 4.97 | | 5.01 | None | 0.10 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.125 | 0.582 | 0.339 | 0.38 |
| A | 6 | 0.021 | 0.206 | 0.469 | 0.05 |
| Bs | 11 | 0.024 | 0.640 | 0.273 | 0.10 |
| Bw | 9 | 0.078 | 0.241 | 0.253 | 0.47 |
| C | 11 | 0.061 | 0.060 | 0.287 | 0.35 |

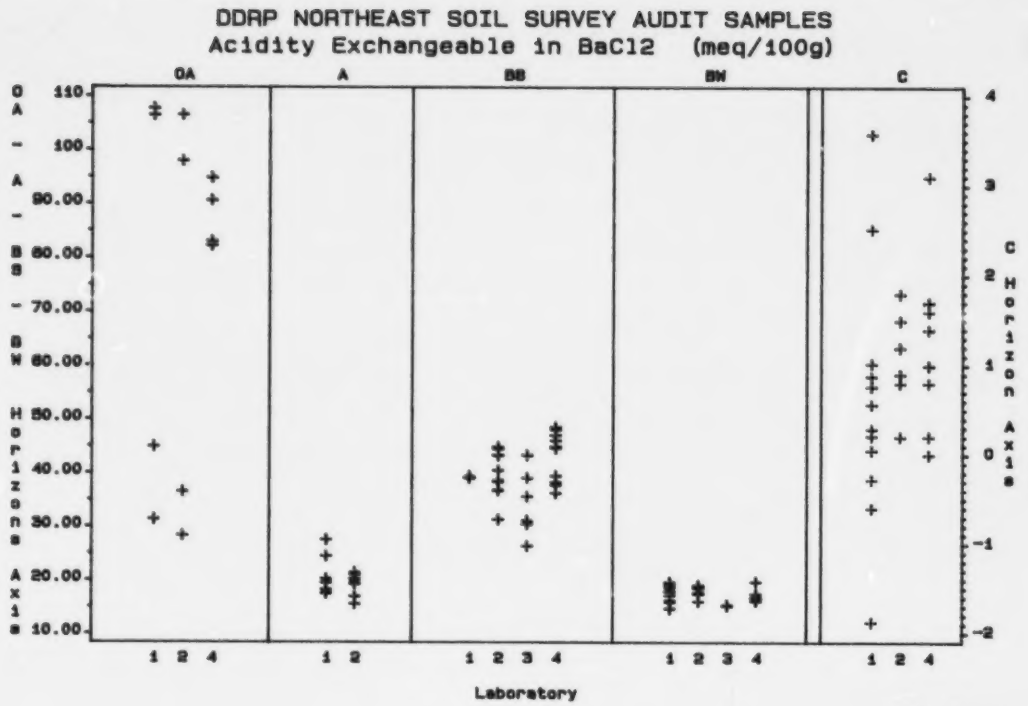
Figure A.2. Interlaboratory difference analysis of pH in 0.002 M $CaCl_2$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 3.00 | 3.00 | | 3.02 | None | 0.02 |
| A | 4.02 | 3.95 | | | 2 < 1 | 0.07 |
| Bs | 3.96 | 3.93 | 3.94 | 3.93 | None | 0.04 |
| Bw | 4.57 | 4.46 | 4.58 | 4.56 | None | 0.11 |
| C | 4.72 | 4.87 | | 4.73 | None | 0.16 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.027 | 0.777 | 0.348 | 0.06 |
| A | 6 | 0.026 | 0.009 | 0.452 | 0.16 |
| Bs | 11 | 0.050 | 0.844 | 0.309 | 0.11 |
| Bw | 9 | 0.233 | 0.903 | 0.310 | 0.31 |
| C | 11 | 0.096 | 0.095 | 0.277 | 0.56 |

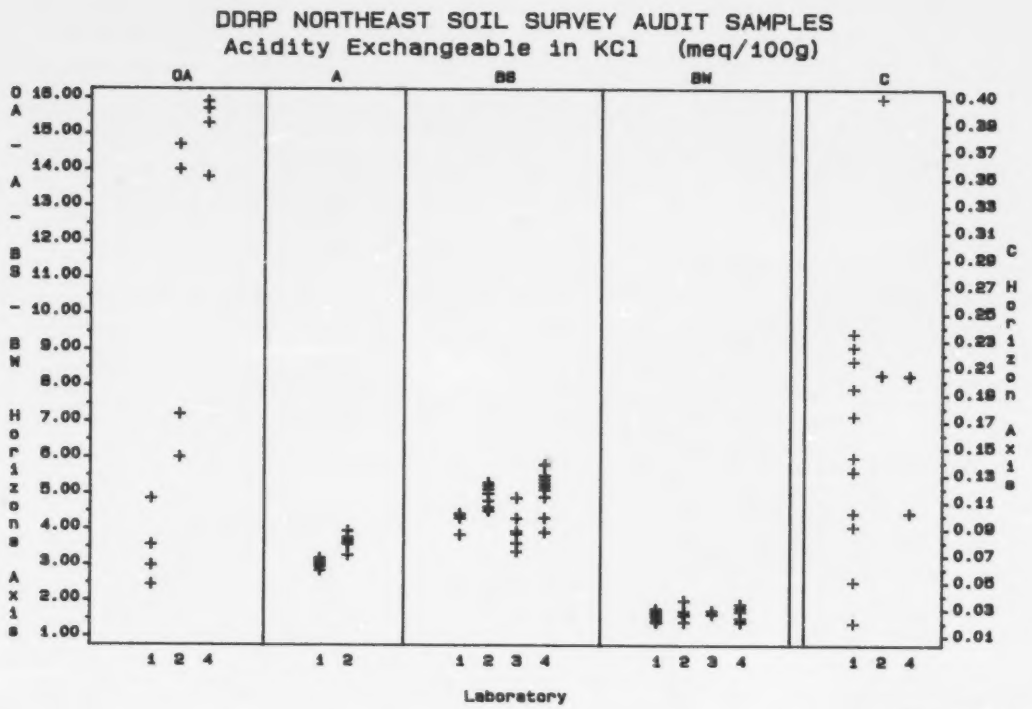
Figure A.3. Interlaboratory difference analysis of pH in 0.01 M $CaCl_2$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 72.61 | 67.30 | | 87.65 | None | 20.35 |
| A | 20.55 | 19.22 | | | None | 1.33 |
| Bs | 39.09 | 39.71 | 34.24 | 43.04 | None | 8.80 |
| Bw | 17.19 | 18.16 | 15.29 | 17.13 | None | 2.87 |
| C | 0.59 | 1.07 | | 1.25 | None | 0.66 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 40.270 | 0.877 | 25.002 | 0.81 |
| A | 6 | 3.020 | 0.557 | 9.209 | 0.14 |
| Bs | 11 | 4.183 | 0.091 | 12.701 | 0.69 |
| Bw | 9 | 1.247 | 0.273 | 6.520 | 0.44 |
| C | 11 | 0.991 | 0.548 | 3.110 | 0.21 |

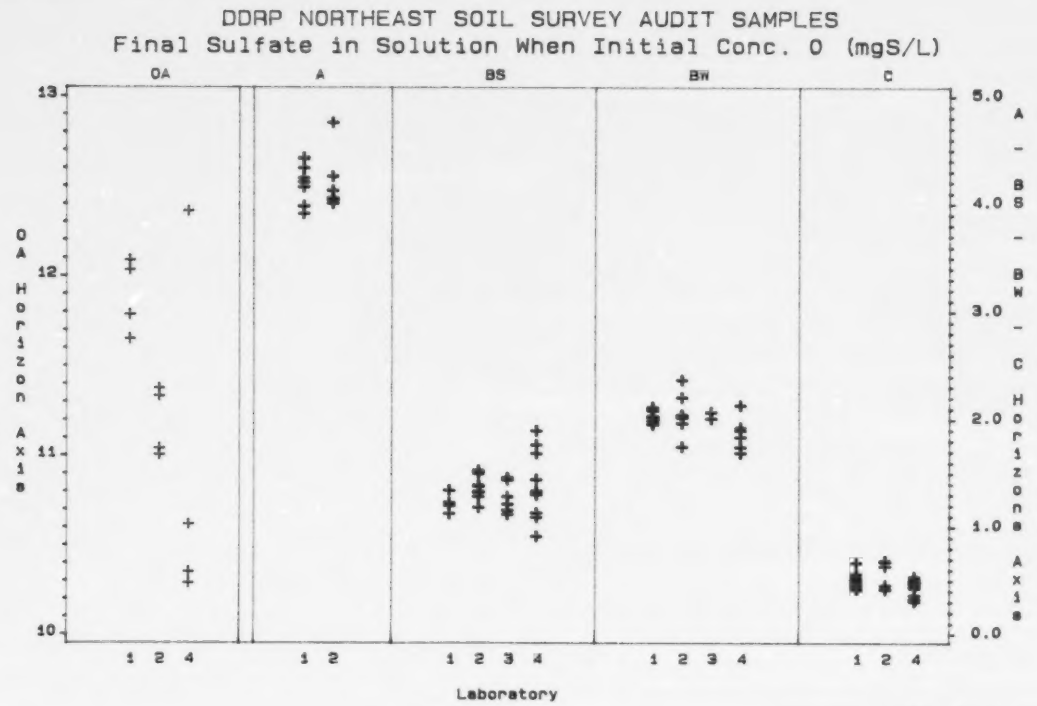
Figure A.4. Interlaboratory difference analysis of acidity in $BaCl_2$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 3.46 | 10.47 | | 15.17 | None | 11.72 |
| A | 3.01 | 3.64 | | | 1 < 2 | 0.63 |
| Bs | 4.24 | 4.82 | 3.99 | 5.12 | 3 < 4 | 1.13 |
| Bw | 1.59 | 1.65 | 1.67 | 1.62 | None | 0.08 |
| C | 0.14 | 0.23 | | 0.17 | None | 0.09 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 3.262 | 0.081 | 4.191 | 2.80 |
| A | 6 | 0.121 | <0.001 | 2.150 | 0.29 |
| Bs | 11 | 0.466 | 0.029 | 1.551 | 0.73 |
| Bw | 9 | 0.134 | 0.891 | 1.070 | 0.08 |
| C | 11 | 0.059 | 0.130 | 0.392 | 0.24 |

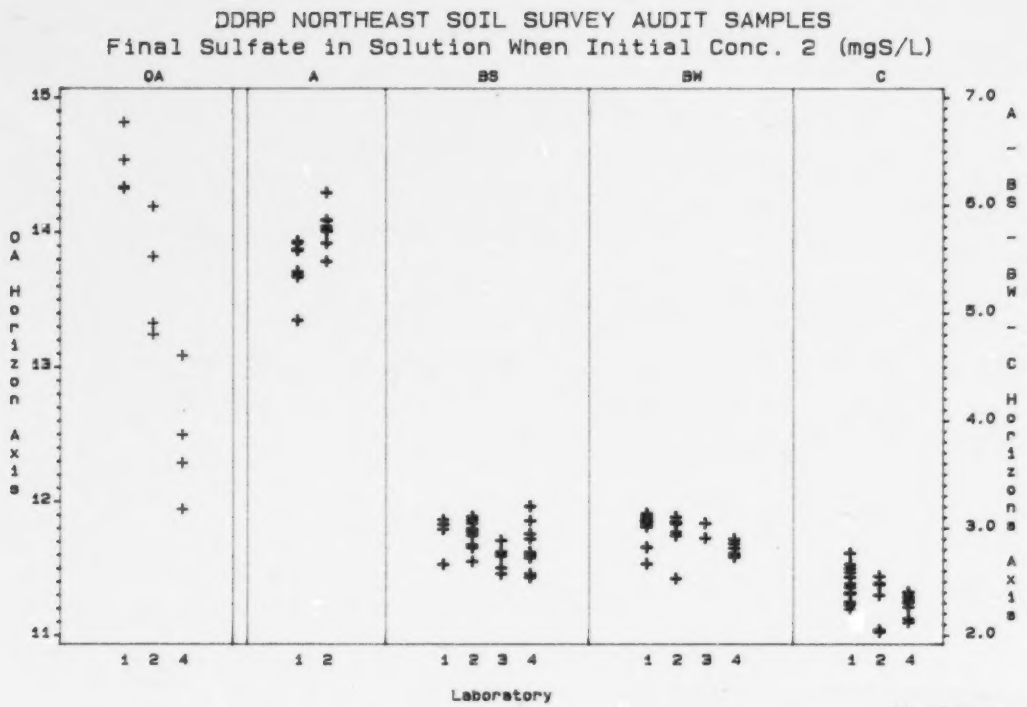
Figure A.5. Interlaboratory difference analysis of acidity in KCl.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 11.88 | 11.19 | | 10.90 | None | 0.98 |
| A | 4.21 | 4.16 | | | None | 0.04 |
| Bs | 1.22 | 1.38 | 1.28 | 1.39 | None | 0.16 |
| Bw | 2.03 | 2.05 | 2.04 | 1.87 | None | 0.18 |
| C | 0.50 | 0.55 | | 0.44 | None | 0.11 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.344 | 0.131 | 3.190 | 0.31 |
| A | 6 | 0.178 | 0.747 | 0.982 | 0.04 |
| Bs | 11 | 0.202 | 0.699 | 0.295 | 0.56 |
| Bw | 9 | 0.126 | 0.303 | 0.404 | 0.45 |
| C | 11 | 0.072 | 0.146 | 0.363 | 0.30 |

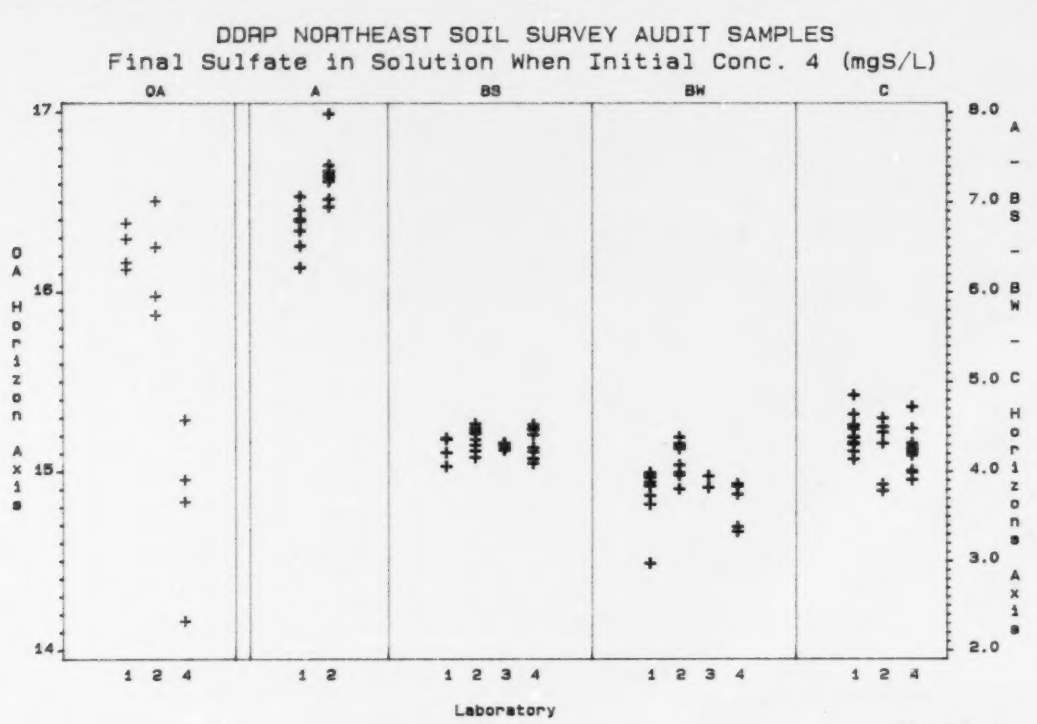
Figure A.6. Interlaboratory difference analysis of final sulfate when initial concentration is 0 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 14.50 | 13.64 | | 12.45 | 4 < 1,2 | 2.05 |
| A | 5.43 | 5.79 | | | None | 0.35 |
| Bs | 2.94 | 2.94 | 2.73 | 2.87 | None | 0.22 |
| Bw | 2.98 | 2.96 | 2.98 | 2.80 | None | 0.18 |
| C | 2.48 | 2.33 | | 2.30 | None | 0.17 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.208 | 0.005 | 3.116 | 0.66 |
| A | 6 | 0.205 | 0.051 | 0.772 | 0.46 |
| Bs | 11 | 0.164 | 0.352 | 0.413 | 0.52 |
| Bw | 9 | 0.138 | 0.364 | 0.423 | 0.42 |
| C | 11 | 0.161 | 0.213 | 0.333 | 0.52 |

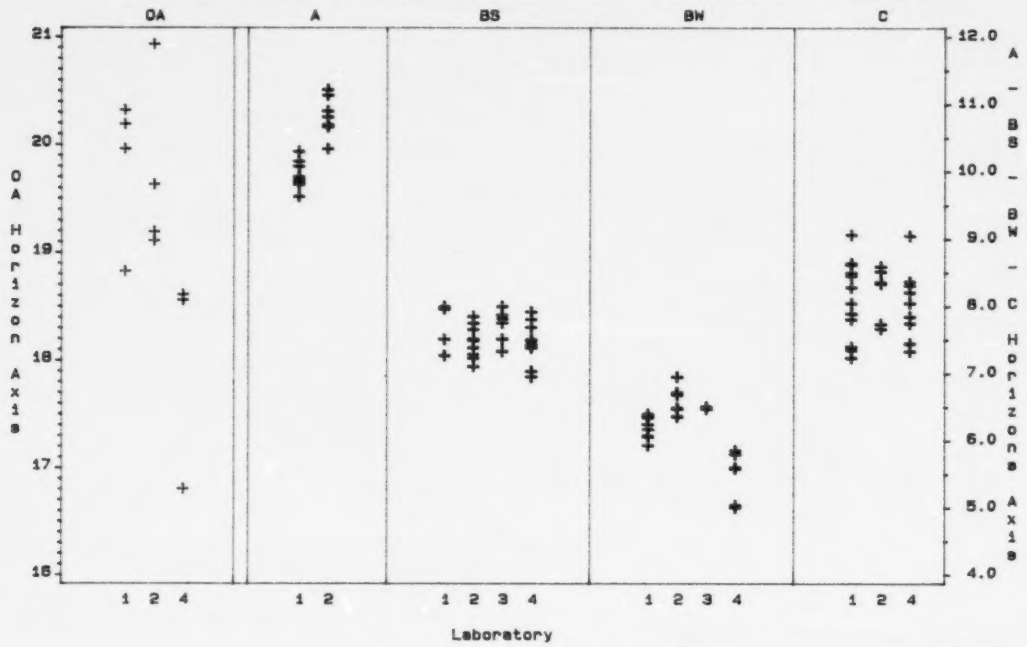
Figure A.7. Interlaboratory difference analysis of final sulfate when initial concentration is 2 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 16.24 | 16.15 | | 14.81 | 4 < 1 | 1.43 |
| A | 6.72 | 7.31 | | | 1 < 2 | 0.59 |
| Bs | 4.24 | 4.38 | 4.28 | 4.31 | None | 0.13 |
| Bw | 3.77 | 4.12 | 3.88 | 3.66 | None | 0.47 |
| C | 4.42 | 4.24 | | 4.23 | None | 0.19 |

| Audit sample ANOVA summary Ho: No differences among laboratories' reported values | | | | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Horizon | Error DF | Standard deviation | Significance level | | |
| Oa | 3 | 0.316 | 0.034 | 3.513 | 0.41 |
| A | 6 | 0.244 | 0.015 | 0.804 | 0.73 |
| Bs | 11 | 0.120 | 0.538 | 0.590 | 0.22 |
| Bw | 9 | 0.201 | 0.057 | 0.593 | 0.78 |
| C | 11 | 0.214 | 0.324 | 0.434 | 0.43 |

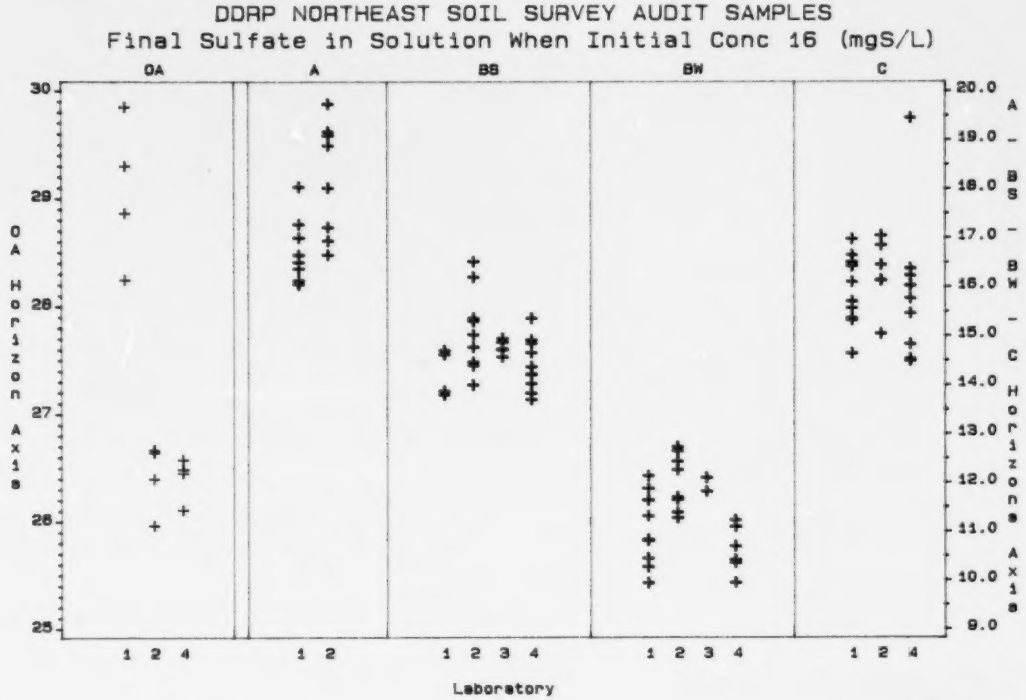
Figure A.8. Interlaboratory difference analysis of final sulfate when initial concentration is 4 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 19.82 | 19.71 | | 18.13 | None | 1.69 |
| A | 9.94 | 10.80 | | | 1 < 2 | 0.86 |
| Bs | 7.67 | 7.47 | 7.71 | 7.45 | None | 0.26 |
| Bw | 6.22 | 6.58 | 6.48 | 5.47 | 4 < 1,2,3 | 1.11 |
| C | 8.10 | 8.20 | | 7.98 | None | 0.22 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.636 | 0.127 | 3.529 | 0.48 |
| A | 6 | 0.235 | 0.002 | 1.125 | 0.76 |
| Bs | 11 | 0.259 | 0.460 | 0.947 | 0.27 |
| Bw | 9 | 0.244 | 0.001 | 0.879 | 1.26 |
| C | 11 | 0.474 | 0.808 | 0.829 | 0.27 |

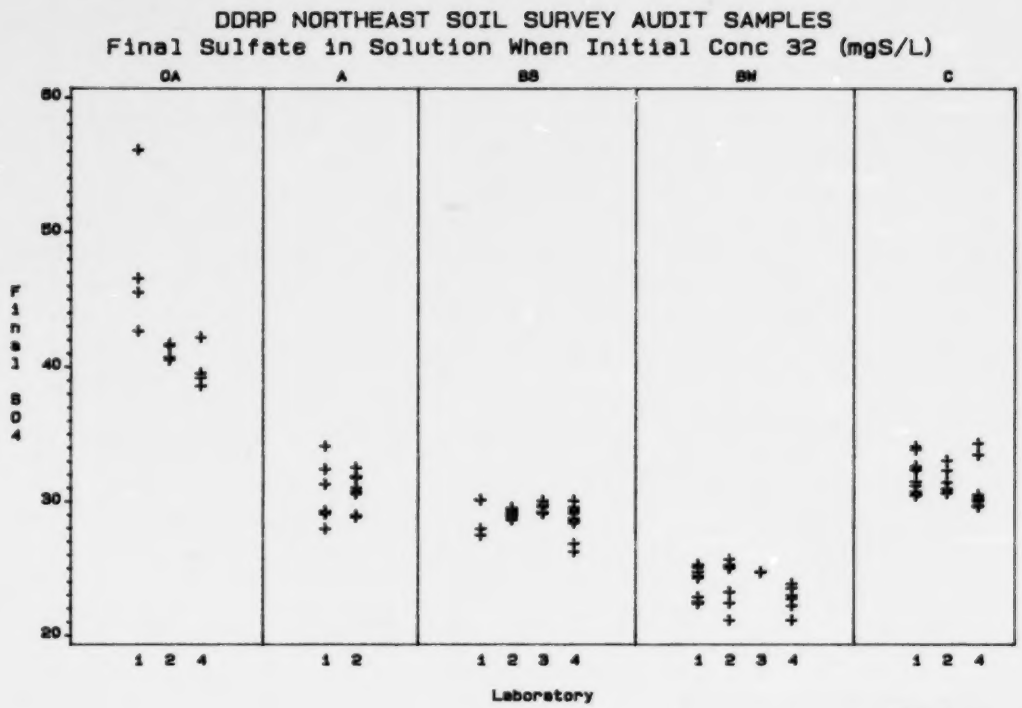
Figure A.9. Interlaboratory difference analysis of final sulfate when initial concentration is 8 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 29.06 | 26.41 | | 26.40 | 2,4 < 1 | 2.66 |
| A | 16.74 | 18.21 | | | None | 1.47 |
| Bs | 14.23 | 15.12 | 14.78 | 14.40 | None | 0.89 |
| Bw | 11.08 | 11.99 | 11.94 | 10.61 | None | 1.38 |
| C | 16.00 | 16.27 | | 15.91 | None | 0.36 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values — Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.201 | 0.001 | 3.681 | 0.72 |
| A | 6 | 0.928 | 0.067 | 2.017 | 0.73 |
| Bs | 11 | 0.605 | 0.240 | 1.898 | 0.47 |
| Bw | 9 | 0.601 | 0.055 | 1.677 | 0.83 |
| C | 11 | 0.839 | 0.842 | 1.355 | 0.26 |

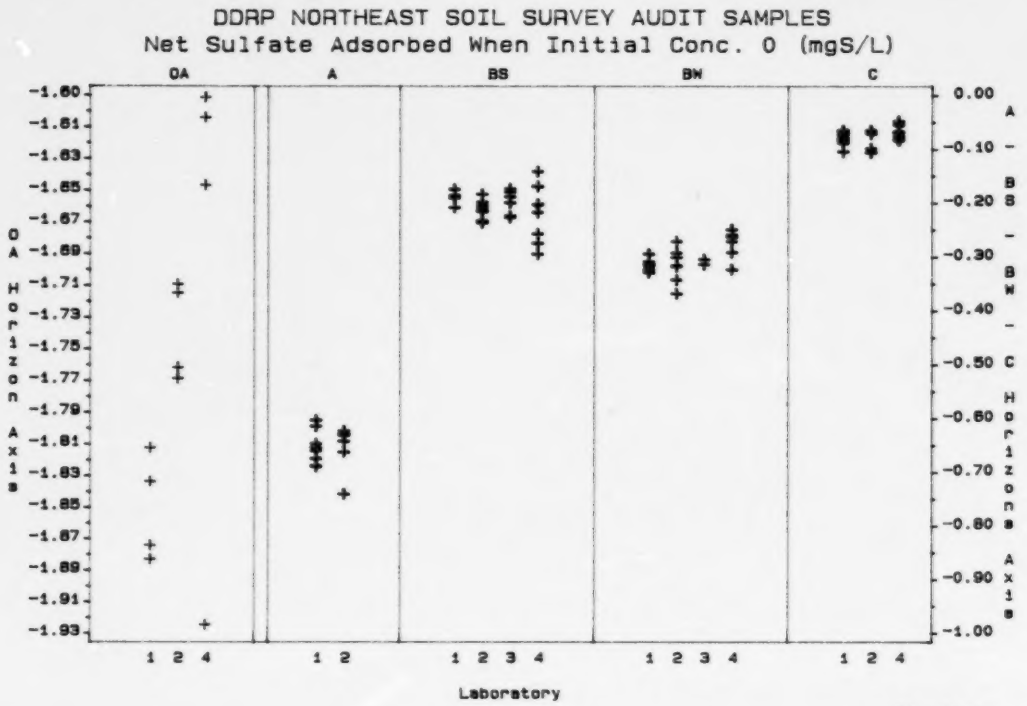
Figure A.10. Interlaboratory difference analysis of final sulfate when initial concentration is 16 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 47.72 | 41.13 | | 39.90 | None | 7.82 |
| A | 30.27 | 30.77 | | | None | 0.50 |
| Bs | 28.93 | 29.02 | 29.49 | 28.53 | None | 0.96 |
| Bw | 23.92 | 24.14 | 24.74 | 22.73 | None | 2.01 |
| C | 31.90 | 31.50 | | 31.10 | None | 0.80 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 2.596 | 0.105 | 4.681 | 1.67 |
| A | 6 | 1.608 | 0.678 | 3.264 | 0.15 |
| Bs | 11 | 0.720 | 0.377 | 3.132 | 0.31 |
| Bw | 9 | 1.370 | 0.498 | 2.864 | 0.70 |
| C | 11 | 1.381 | 0.646 | 2.068 | 0.39 |

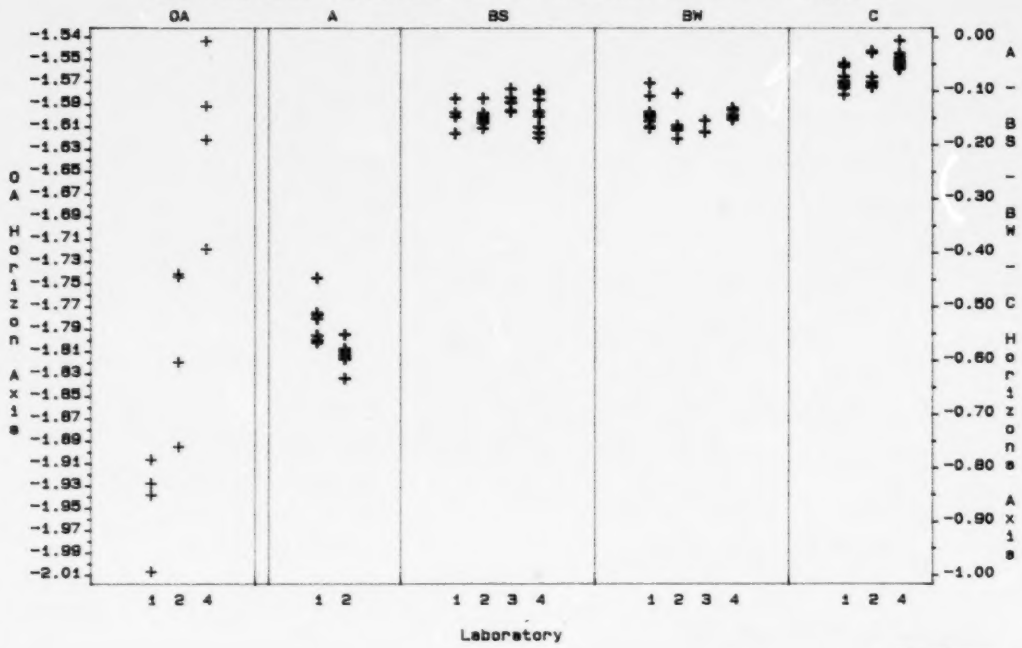
Figure A.11. Interlaboratory difference analysis of final sulfate when initial concentration is 32 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | -1.85 | -1.74 | | -1.70 | None | 0.15 |
| A | -0.65 | -0.65 | | | None | 0.01 |
| Bs | -0.19 | -0.22 | -0.20 | -0.21 | None | 0.02 |
| Bw | -0.31 | -0.32 | -0.31 | -0.28 | None | 0.04 |
| C | -0.08 | -0.09 | | -0.07 | None | 0.02 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.053 | 0.123 | 0.497 | 0.31 |
| A | 6 | 0.029 | 0.802 | 0.152 | 0.04 |
| Bs | 11 | 0.032 | 0.736 | 0.046 | 0.54 |
| Bw | 9 | 0.022 | 0.152 | 0.068 | 0.58 |
| C | 11 | 0.011 | 0.156 | 0.057 | 0.30 |

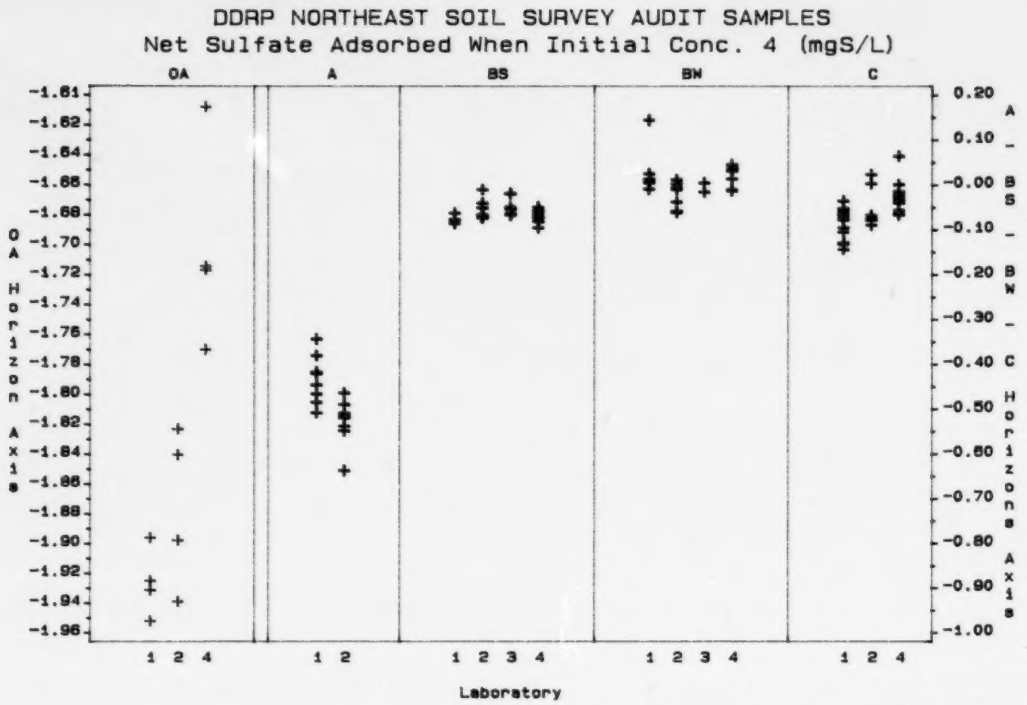
Figure A.12. Interlaboratory difference analysis of net sulfate when initial concentration is 0 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | -1.95 | -1.80 | | -1.62 | 1,2 < 4 | 0.32 |
| A | -0.53 | -0.59 | | | 2 < 1 | 0.06 |
| Bs | -0.15 | -0.15 | -0.12 | -0.14 | None | 0.03 |
| Bw | -0.14 | -0.16 | -0.17 | -0.14 | None | 0.02 |
| C | -0.08 | -0.07 | | -0.04 | 1 < 4 | 0.03 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.039 | 0.009 | 0.488 | 0.66 |
| A | 6 | 0.030 | 0.032 | 0.119 | 0.51 |
| Bs | 11 | 0.018 | 0.249 | 0.062 | 0.46 |
| Bw | 9 | 0.020 | 0.373 | 0.063 | 0.39 |
| C | 11 | 0.020 | 0.047 | 0.051 | 0.67 |

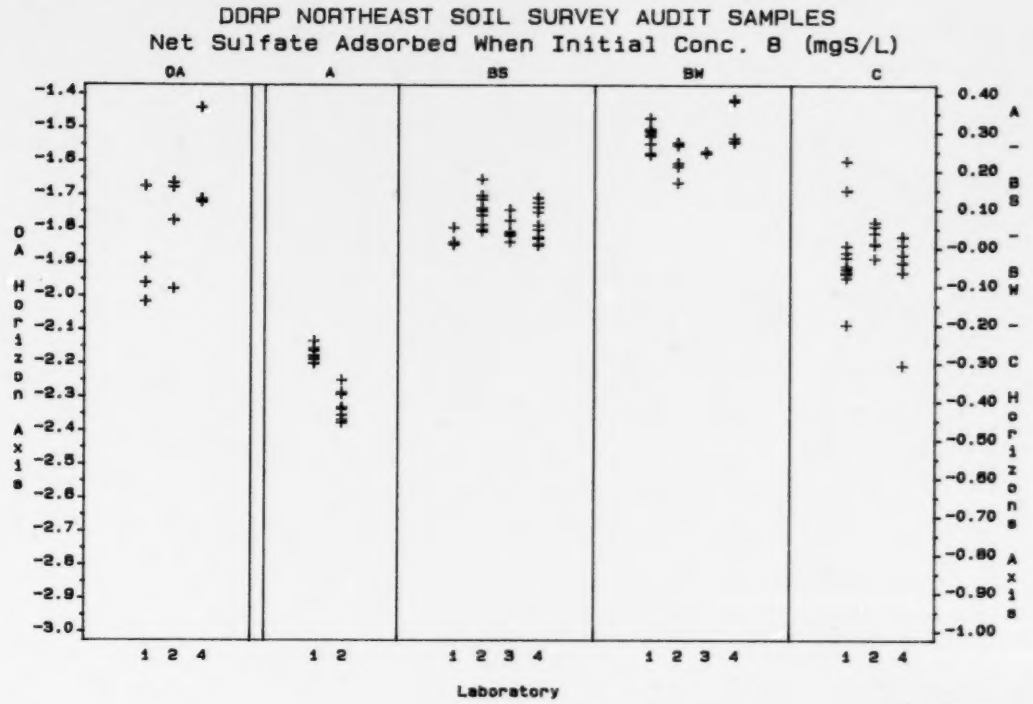
Figure A.13. Interlaboratory difference analysis of net sulfate when initial concentration is 2 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | -1.93 | -1.88 | | -1.71 | 1 < 4 | 0.22 |
| A | -0.43 | -0.53 | | | 2 < 1 | 0.09 |
| Bs | -0.08 | -0.06 | -0.05 | -0.07 | None | 0.03 |
| Bw | 0.02 | -0.03 | -0.01 | 0.02 | None | 0.05 |
| C | -0.09 | -0.05 | | -0.03 | 1 < 4 | 0.06 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.049 | 0.042 | 0.525 | 0.41 |
| A | 6 | 0.050 | 0.036 | 0.118 | 0.80 |
| Bs | 11 | 0.015 | 0.101 | 0.088 | 0.36 |
| Bw | 9 | 0.025 | 0.069 | 0.091 | 0.53 |
| C | 11 | 0.034 | 0.042 | 0.072 | 0.83 |

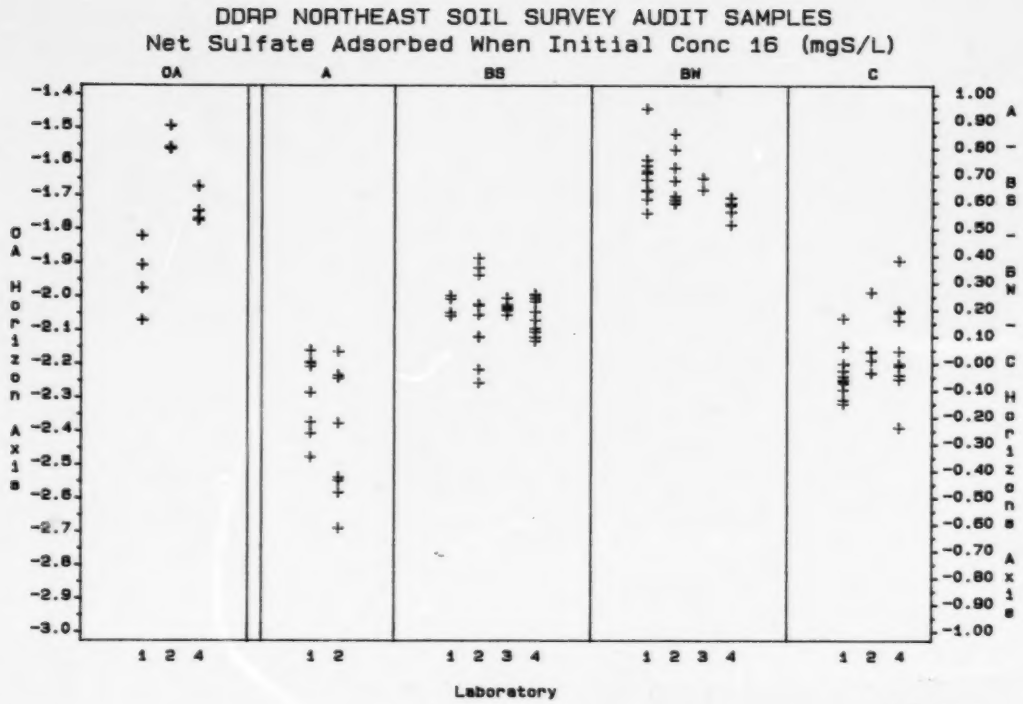
Figure A.14. Interlaboratory difference analysis of net sulfate when initial concentration is 4 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | -1.89 | -1.78 | | -1.65 | None | 0.24 |
| A | -0.28 | -0.41 | | | 2 < 1 | 0.13 |
| Bs | 0.02 | 0.10 | 0.04 | 0.06 | None | 0.08 |
| Bw | 0.29 | 0.23 | 0.24 | 0.31 | None | 0.08 |
| C | -0.02 | 0.02 | | -0.05 | None | 0.07 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.132 | 0.330 | 0.563 | 0.42 |
| A | 6 | 0.026 | <0.001 | 0.181 | 0.72 |
| Bs | 11 | 0.037 | 0.096 | 0.175 | 0.45 |
| Bw | 9 | 0.042 | 0.137 | 0.128 | 0.60 |
| C | 11 | 0.090 | 0.592 | 0.138 | 0.50 |

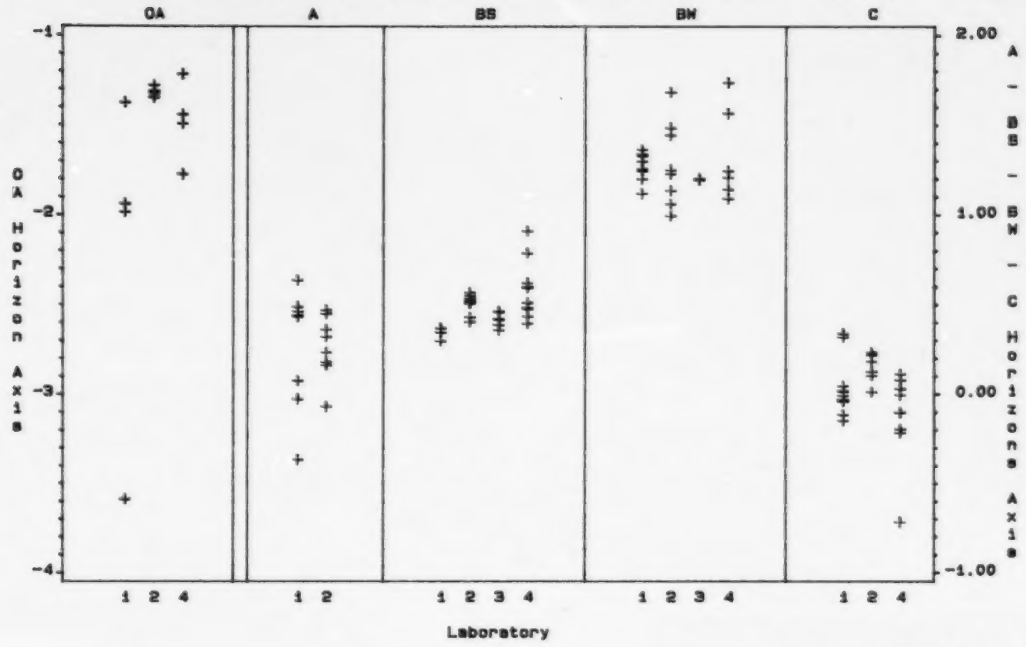
Figure A.15. Interlaboratory difference analysis of net sulfate when initial concentration is 8 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | -1.94 | -1.54 | | -1.74 | 1 < 4 < 2 | 0.40 |
| A | -0.12 | -0.29 | | | None | 0.17 |
| Bs | 0.21 | 0.17 | 0.20 | 0.17 | None | 0.04 |
| Bw | 0.69 | 0.68 | 0.66 | 0.58 | None | 0.12 |
| C | -0.05 | 0.04 | | 0.05 | None | 0.10 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.028 | 0.002 | 0.616 | 0.65 |
| A | 6 | 0.206 | 0.292 | 0.286 | 0.59 |
| Bs | 11 | 0.106 | 0.954 | 0.289 | 0.13 |
| Bw | 9 | 0.085 | 0.334 | 0.270 | 0.44 |
| C | 11 | 0.086 | 0.152 | 0.214 | 0.48 |

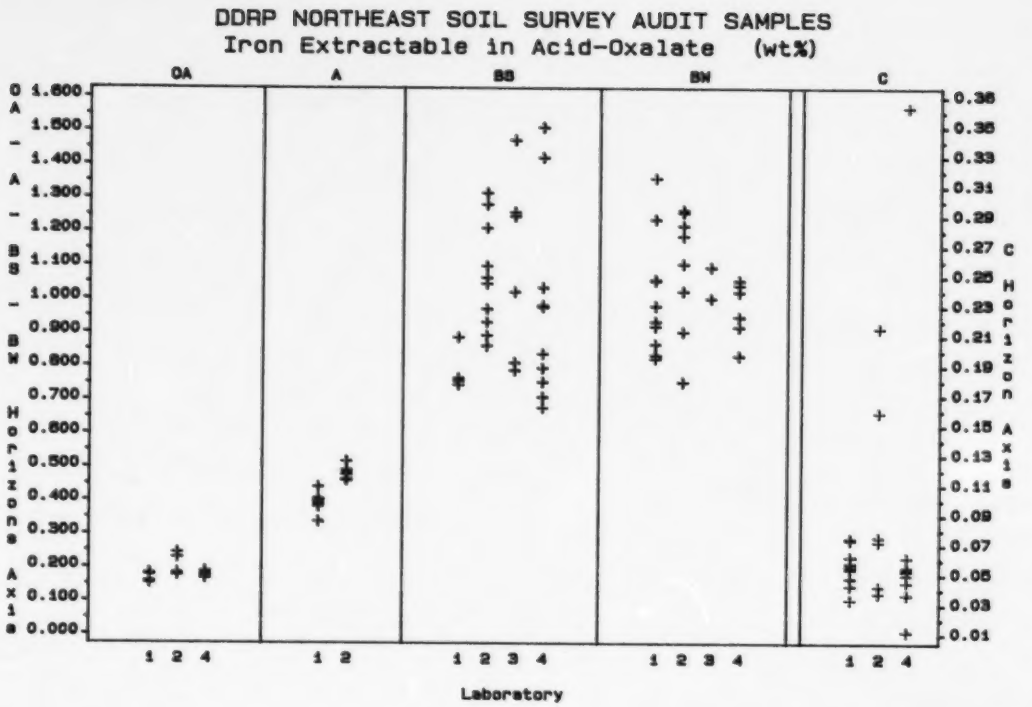
Figure A.16. Interlaboratory difference analysis of net sulfate when initial concentration is 16 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | -2.22 | -1.32 | | -1.48 | None | 0.91 |
| A | 0.26 | 0.25 | | | None | 0.00 |
| Bs | 0.33 | 0.50 | 0.40 | 0.57 | 1 < 2,4; 3 < 4 | 0.24 |
| Bw | 1.26 | 1.27 | 1.19 | 1.32 | None | 0.13 |
| C | 0.01 | 0.13 | | -0.12 | None | 0.25 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.444 | 0.241 | 0.817 | 1.11 |
| A | 6 | 0.247 | 0.984 | 0.523 | 0.01 |
| Bs | 11 | 0.056 | 0.001 | 0.465 | 0.52 |
| Bw | 9 | 0.194 | 0.941 | 0.449 | 0.30 |
| C | 11 | 0.155 | 0.117 | 0.301 | 0.84 |

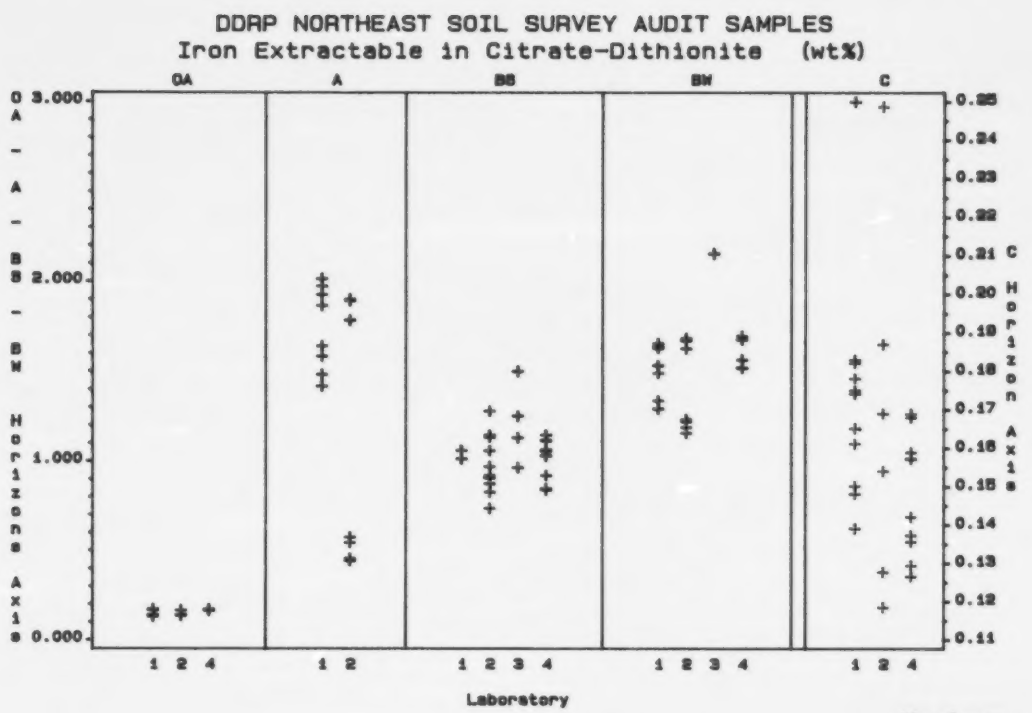
Figure A.17. Interlaboratory difference analysis of net sulfate when initial concentration is 32 mg S/L.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.167 | 0.207 | | 0.175 | None | 0.04 |
| A | 0.393 | 0.479 | | | 1 < 2 | 0.09 |
| Bs | 0.785 | 1.066 | 1.098 | 0.968 | None | 0.31 |
| Bw | 1.005 | 1.088 | 1.046 | 0.968 | None | 0.12 |
| C | 0.056 | 0.098 | | 0.077 | None | 0.04 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.024 | 0.340 | 0.208 | 0.19 |
| A | 6 | 0.017 | <0.001 | 0.255 | 0.34 |
| Bs | 11 | 0.227 | 0.448 | 0.519 | 0.60 |
| Bw | 9 | 0.164 | 0.791 | 0.254 | 0.47 |
| C | 11 | 0.053 | 0.535 | 0.140 | 0.30 |

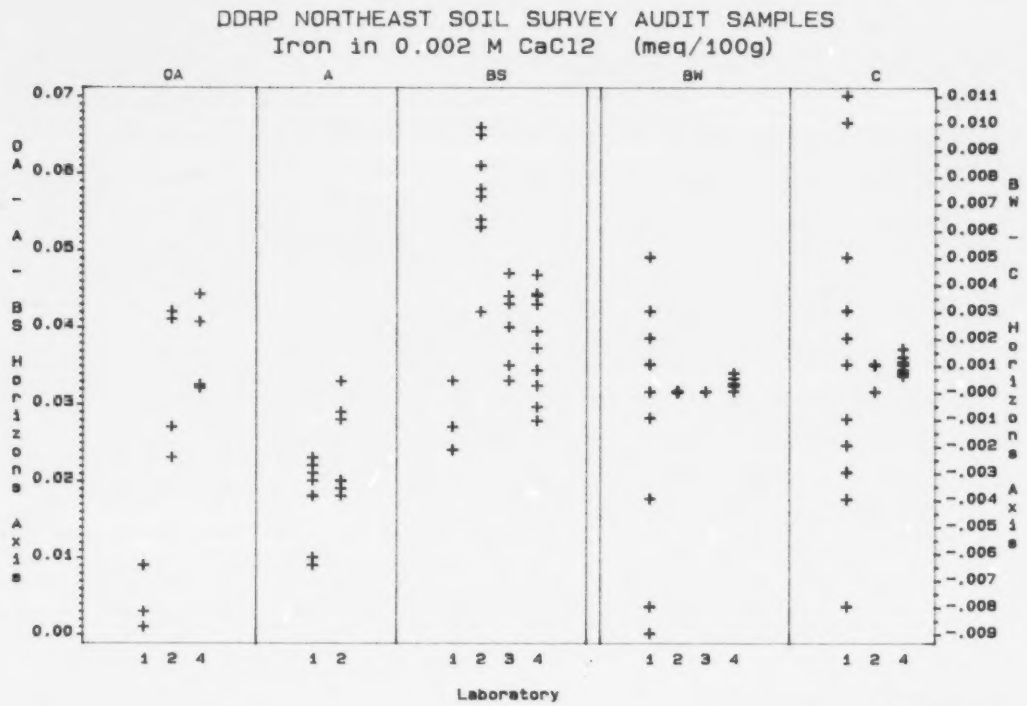
Figure A.18. Interlaboratory difference analysis of iron extractable in acid-oxalate.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.151 | 0.144 | | 0.166 | None | 0.02 |
| A | 1.736 | 1.170 | | | None | 0.57 |
| Bs | 1.032 | 0.982 | 1.264 | 1.014 | None | 0.28 |
| Bw | 1.502 | 1.430 | 2.154 | 1.609 | 2 < 3 | 0.72 |
| C | 0.180 | 0.167 | | 0.148 | None | 0.03 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values — Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.014 | 0.395 | 0.257 | 0.09 |
| A | 6 | 0.575 | 0.214 | 0.371 | 1.52 |
| Bs | 11 | 0.146 | 0.102 | 0.594 | 0.48 |
| Bw | 9 | 0.184 | 0.037 | 0.530 | 1.37 |
| C | 11 | 0.033 | 0.321 | 0.295 | 0.11 |

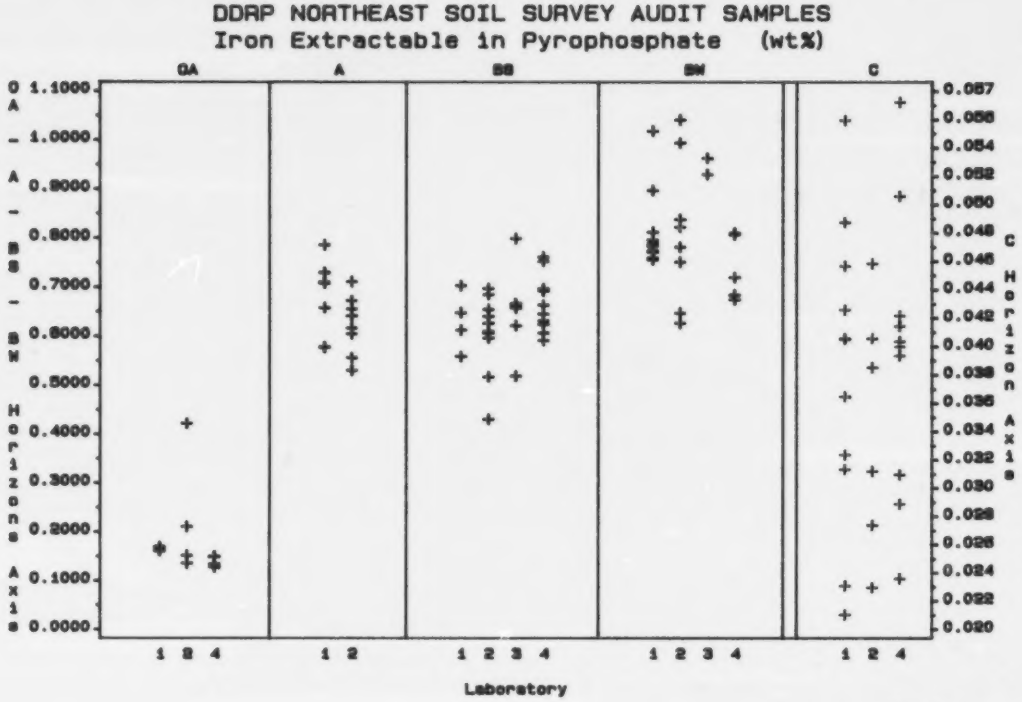
Figure A.19. Interlaboratory difference analysis of iron in citrate-dithionite.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.005 | 0.033 | | 0.037 | None | 0.032 |
| A | 0.018 | 0.023 | | | None | 0.006 |
| Bs | 0.027 | 0.057 | 0.040 | 0.038 | 1,3,4 < 2 | 0.030 |
| Bw | -.001 | 0.000 | 0.000 | 0.000 | None | 0.001 |
| C | 0.001 | 0.001 | | 0.001 | None | 0.000 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.008 | 0.058 | 0.041 | 0.78 |
| A | 6 | 0.006 | 0.201 | 0.007 | 0.79 |
| Bs | 11 | 0.006 | <0.001 | 0.006 | 4.77 |
| Bw | 9 | 0.003 | 0.937 | 0.002 | 0.67 |
| C | 11 | 0.004 | 0.999 | 0.002 | 0.05 |

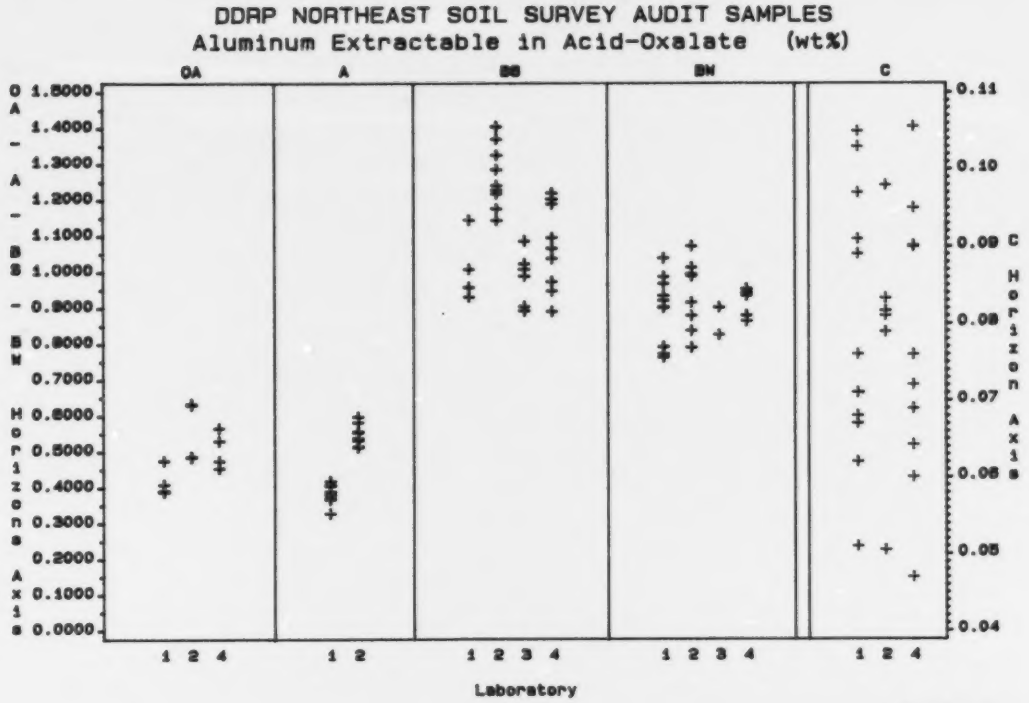
Figure A.20. Interlaboratory difference analysis of iron in 0.002 M $CaCl_2$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.165 | 0.229 | | 0.140 | None | 0.090 |
| A | 0.684 | 0.623 | | | None | 0.061 |
| Bs | 0.630 | 0.606 | 0.654 | 0.666 | None | 0.060 |
| Bw | 0.815 | 0.813 | 0.947 | 0.730 | None | 0.216 |
| C | 0.038 | 0.034 | | 0.039 | None | 0.005 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values — Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.071 | 0.509 | 0.185 | 0.48 |
| A | 6 | 0.065 | 0.229 | 0.240 | 0.26 |
| Bs | 11 | 0.057 | 0.418 | 0.405 | 0.15 |
| Bw | 9 | 0.111 | 0.430 | 0.245 | 0.88 |
| C | 11 | 0.008 | 0.715 | 0.046 | 0.11 |

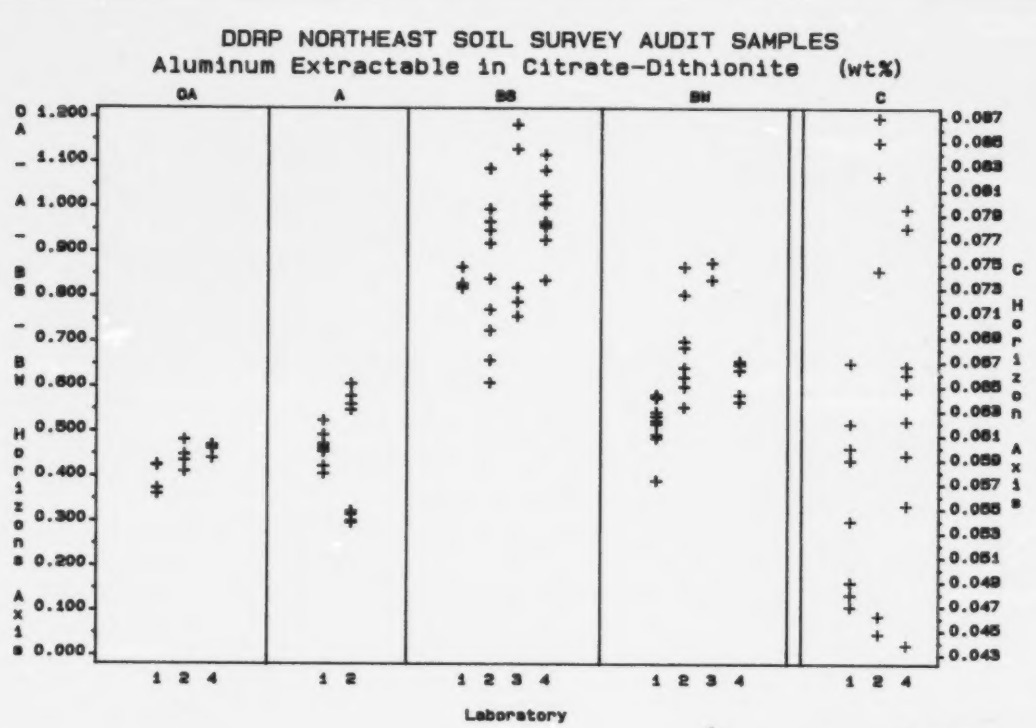
Figure A.21. Interlaboratory difference analysis of iron in pyrophosphate.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.414 | 0.557 | | 0.504 | None | 0.143 |
| A | 0.382 | 0.548 | | | 1 < 2 | 0.166 |
| Bs | 1.009 | 1.279 | 0.983 | 1.082 | 1,3,4 < 2 | 0.296 |
| Bw | 0.896 | 0.935 | 0.862 | 0.920 | None | 0.072 |
| C | 0.079 | 0.079 | | 0.077 | None | 0.002 |

| Audit sample ANOVA summary Ho: No differences among laboratories' reported values | | | | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Horizon | Error DF | Standard deviation | Significance level | | |
| Oa | 3 | 0.072 | 0.279 | 0.164 | 0.87 |
| A | 6 | 0.017 | <0.001 | 0.270 | 0.61 |
| Bs | 11 | 0.075 | 0.001 | 0.592 | 0.50 |
| Bw | 9 | 0.077 | 0.800 | 0.251 | 0.29 |
| C | 11 | 0.015 | 0.971 | 0.105 | 0.02 |

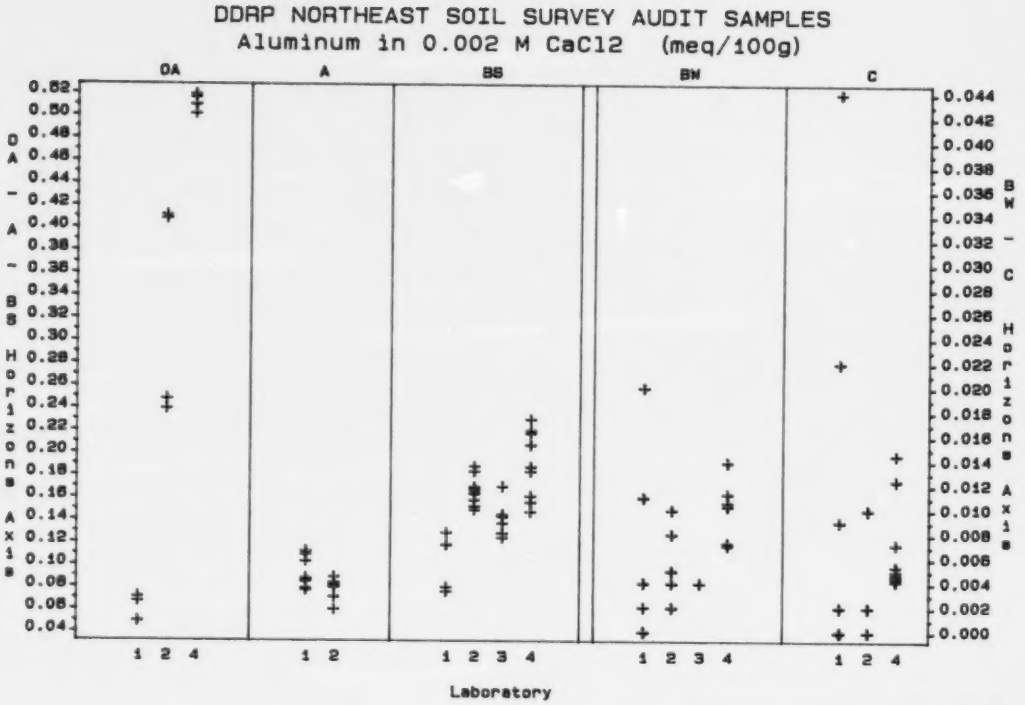
Figure A.22. Interlaboratory difference analysis of aluminum in acid-oxalate.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.394 | 0.442 | | 0.458 | None | 0.064 |
| A | 0.462 | 0.440 | | | None | 0.022 |
| Bs | 0.834 | 0.852 | 0.916 | 0.989 | None | 0.154 |
| Bw | 0.521 | 0.684 | 0.856 | 0.623 | 1 < 3 | 0.335 |
| C | 0.054 | 0.070 | | 0.064 | None | 0.016 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.030 | 0.231 | 0.162 | 0.40 |
| A | 6 | 0.112 | 0.793 | 0.187 | 0.12 |
| Bs | 11 | 0.133 | 0.382 | 0.426 | 0.36 |
| Bw | 9 | 0.076 | 0.010 | 0.162 | 2.07 |
| C | 11 | 0.012 | 0.169 | 0.058 | 0.27 |

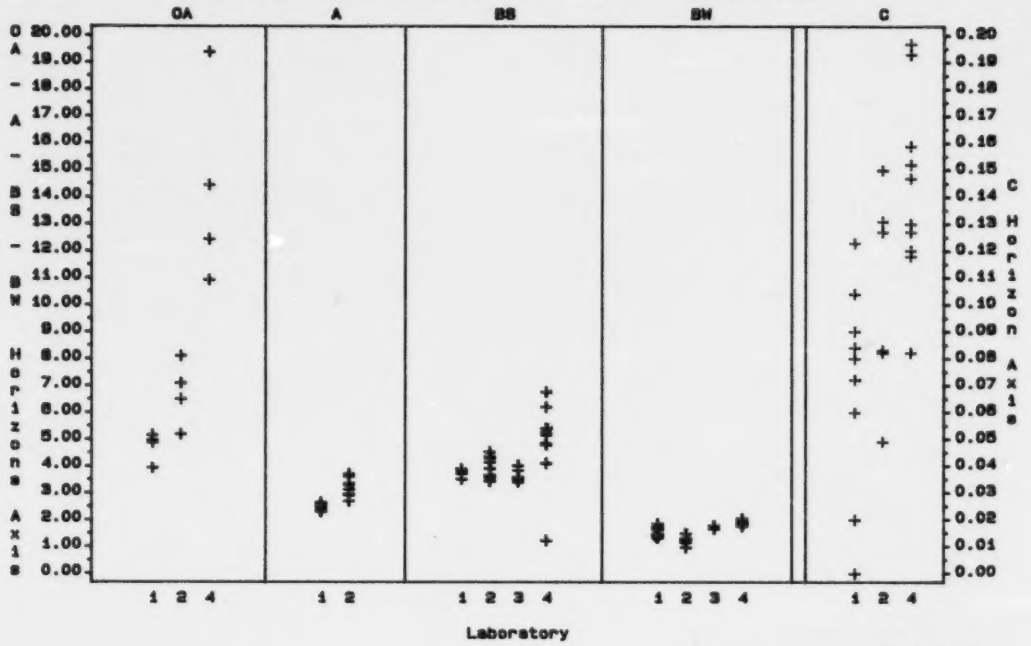
Figure A.23. Interlaboratory difference analysis of aluminum in citrate-dithionite.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.059 | 0.326 | | 0.511 | 1 < 4 | 0.452 |
| A | 0.092 | 0.079 | | | None | 0.014 |
| Bs | 0.101 | 0.166 | 0.141 | 0.192 | 1 < 2,4; 3 < 4 | 0.091 |
| Bw | 0.005 | 0.005 | 0.004 | 0.010 | None | 0.006 |
| C | 0.007 | 0.004 | | 0.007 | None | 0.003 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.068 | 0.016 | 0.184 | 2.45 |
| A | 6 | 0.010 | 0.107 | 0.062 | 0.23 |
| Bs | 11 | 0.021 | 0.002 | 0.026 | 3.47 |
| Bw | 9 | 0.004 | 0.373 | 0.034 | 0.18 |
| C | 11 | 0.009 | 0.906 | 0.009 | 0.30 |

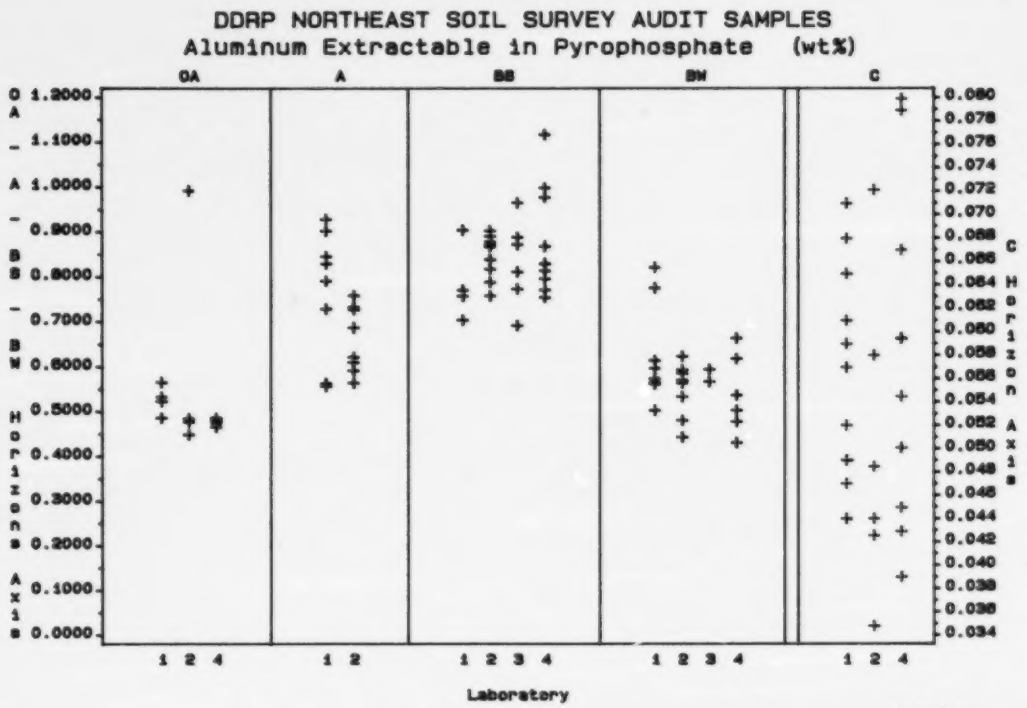
Figure A.24. Interlaboratory difference analysis of aluminum in 0.002 M $CaCl_2$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 4.73 | 6.71 | | 14.29 | 1,2 < 4 | 9.56 |
| A | 2.46 | 3.20 | | | 1 < 2 | 0.74 |
| Bs | 3.72 | 3.92 | 3.63 | 4.78 | None | 1.15 |
| Bw | 1.53 | 1.22 | 1.71 | 1.88 | 2 < 1,3,4; 1 < 4 | 0.66 |
| C | 0.05 | 0.10 | | 0.14 | 1 < 4 | 0.09 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.722 | 0.002 | 2.527 | 3.78 |
| A | 6 | 0.247 | 0.005 | 1.875 | 0.40 |
| Bs | 11 | 0.837 | 0.241 | 1.328 | 0.86 |
| Bw | 9 | 0.109 | <0.001 | 0.847 | 0.78 |
| C | 11 | 0.033 | 0.004 | 0.263 | 0.33 |

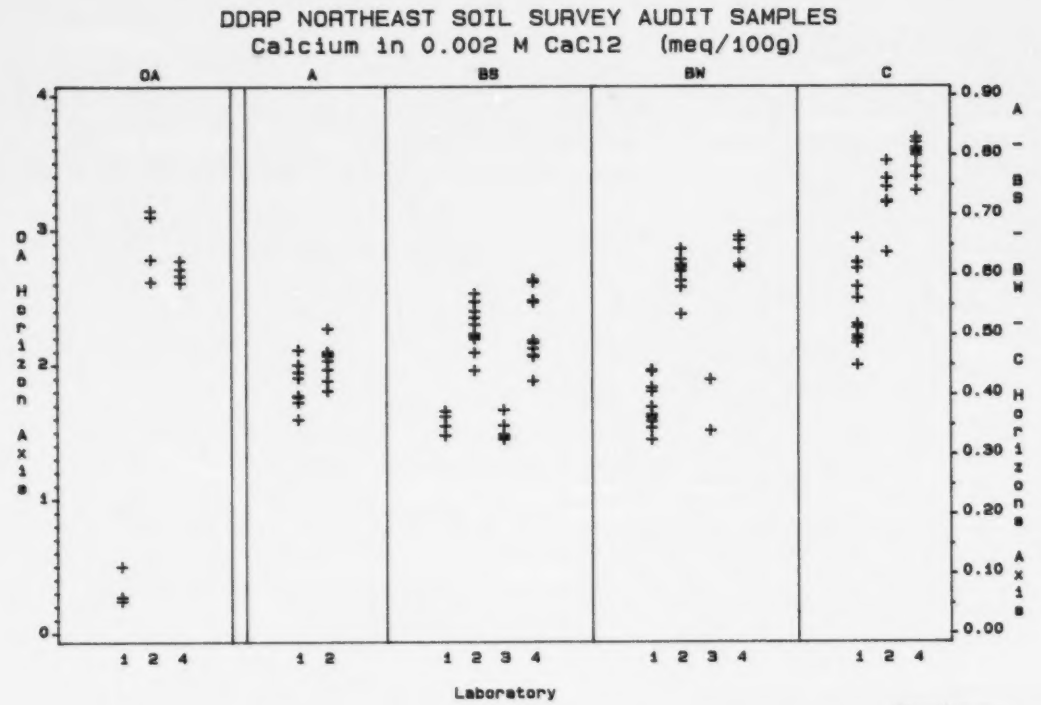
Figure A.25. Interlaboratory difference analysis of aluminum in KCl.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.525 | 0.599 | | 0.475 | None | 0.124 |
| A | 0.767 | 0.660 | | | None | 0.107 |
| Bs | 0.783 | 0.844 | 0.833 | 0.875 | None | 0.092 |
| Bw | 0.617 | 0.548 | 0.579 | 0.537 | None | 0.081 |
| C | 0.055 | 0.050 | | 0.058 | None | 0.008 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.110 | 0.583 | 0.113 | 1.10 |
| A | 6 | 0.114 | 0.234 | 0.174 | 0.61 |
| Bs | 11 | 0.077 | 0.567 | 0.357 | 0.26 |
| Bw | 9 | 0.091 | 0.595 | 0.174 | 0.46 |
| C | 11 | 0.010 | 0.602 | 0.053 | 0.14 |

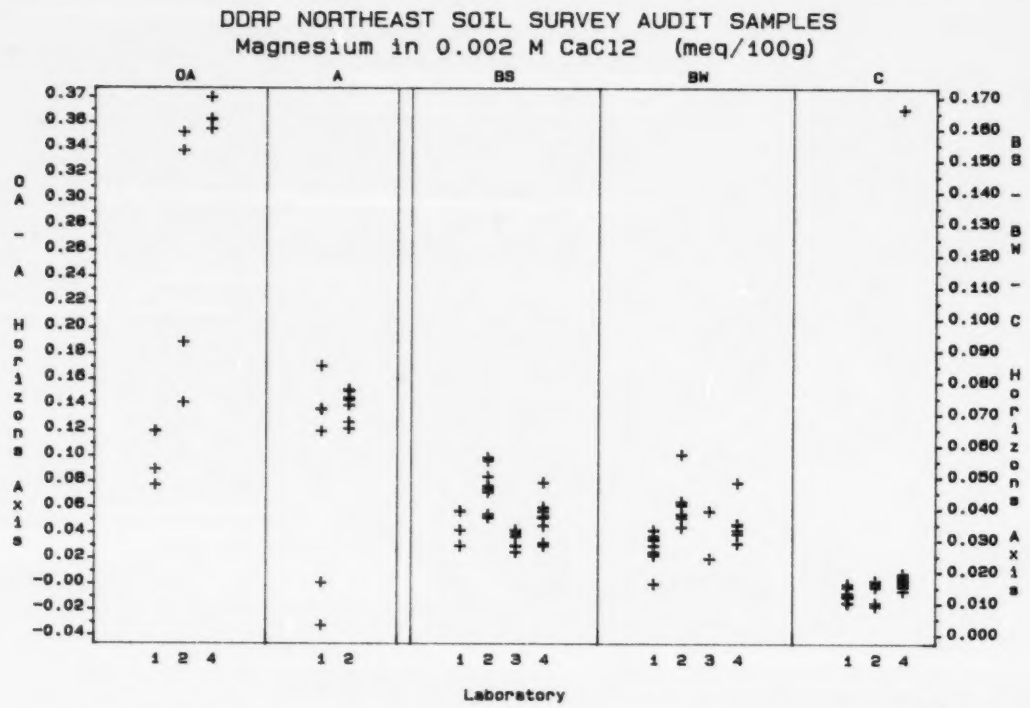
Figure A.26. Interlaboratory difference analysis of aluminum in pyrophosphate.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.321 | 2.912 | | 2.690 | 1 < 2,4 | 2.592 |
| A | 0.414 | 0.454 | | | None | 0.039 |
| Bs | 0.351 | 0.509 | 0.338 | 0.508 | 1,3 < 2,4 | 0.171 |
| Bw | 0.381 | 0.600 | 0.380 | 0.634 | 1,3 < 2,4 | 0.254 |
| C | 0.549 | 0.728 | | 0.796 | 1 < 2,4 | 0.247 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values — Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.182 | 0.001 | 0.709 | 3.66 |
| A | 6 | 0.023 | 0.055 | 0.156 | 0.25 |
| Bs | 11 | 0.043 | <0.001 | 0.140 | 1.23 |
| Bw | 9 | 0.033 | <0.001 | 0.097 | 2.61 |
| C | 11 | 0.051 | <0.001 | 0.117 | 2.11 |

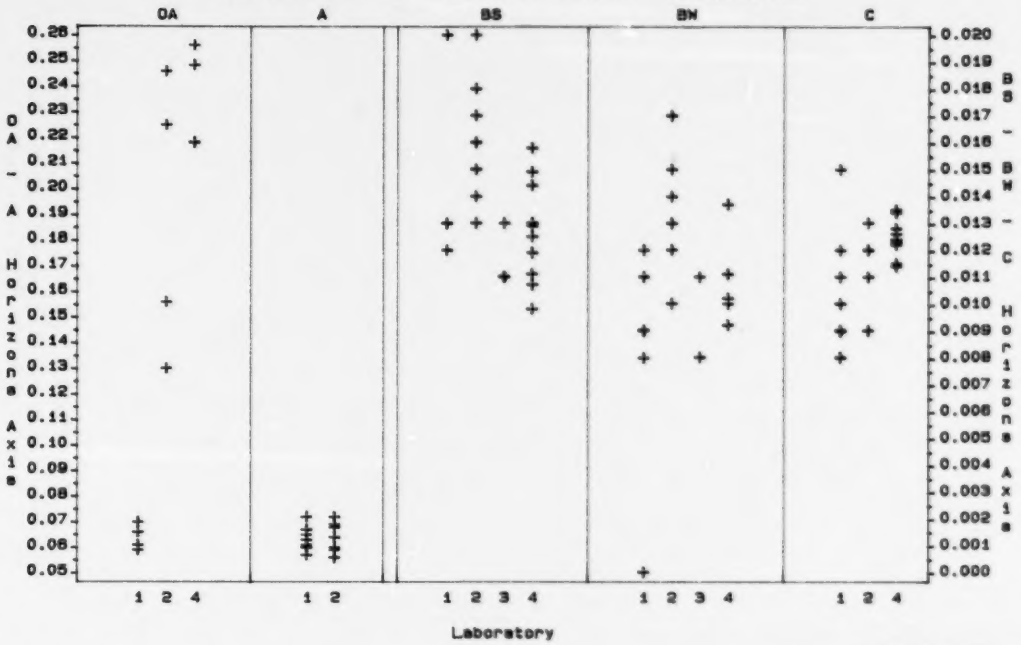
Figure A.27. Interlaboratory difference analysis of calcium in 0.002 M $CaCl_2$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.097 | 0.248 | | 0.355 | None | 0.258 |
| A | 0.097 | 0.136 | | | None | 0.039 |
| Bs | 0.035 | 0.046 | 0.030 | 0.037 | 3 < 2 | 0.016 |
| Bw | 0.028 | 0.041 | 0.032 | 0.035 | 1 < 2 | 0.014 |
| C | 0.012 | 0.014 | | 0.032 | None | 0.020 |

| Audit sample ANOVA summary Ho: No differences among laboratories' reported values | | | | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Horizon | Error DF | Standard deviation | Significance level | | |
| Oa | 3 | 0.073 | 0.086 | 0.222 | 1.16 |
| A | 6 | 0.055 | 0.351 | 0.054 | 0.72 |
| Bs | 11 | 0.005 | 0.004 | 0.019 | 0.85 |
| Bw | 9 | 0.004 | 0.010 | 0.018 | 0.76 |
| C | 11 | 0.020 | 0.287 | 0.055 | 0.36 |

Figure A.28. Interlaboratory difference analysis of magnesium in 0.002 M $CaCl_2$.

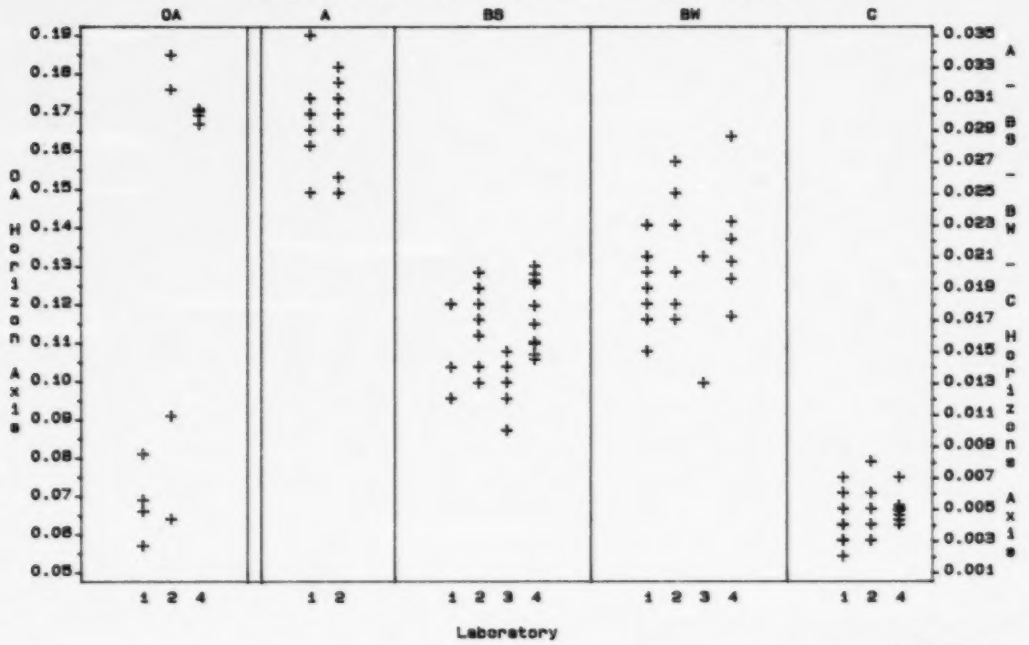



| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.064 | 0.189 | | 0.235 | 1 < 4 | 0.171 |
| A | 0.063 | 0.063 | | | None | 0.000 |
| Bs | 0.014 | 0.016 | 0.011 | 0.013 | 3,4 < 2 | 0.005 |
| Bw | 0.009 | 0.014 | 0.009 | 0.011 | None | 0.005 |
| C | 0.010 | 0.011 | | 0.012 | 1 < 4 | 0.002 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.038 | 0.042 | 0.240 | 0.71 |
| A | 6 | 0.005 | 0.970 | 0.030 | 0.00 |
| Bs | 11 | 0.002 | 0.009 | 0.007 | 0.71 |
| Bw | 9 | 0.002 | 0.054 | 0.004 | 1.16 |
| C | 11 | 0.001 | 0.021 | 0.005 | 0.50 |

Figure A.29. Interlaboratory difference analysis of potassium in 0.002 M $CaCl_2$.

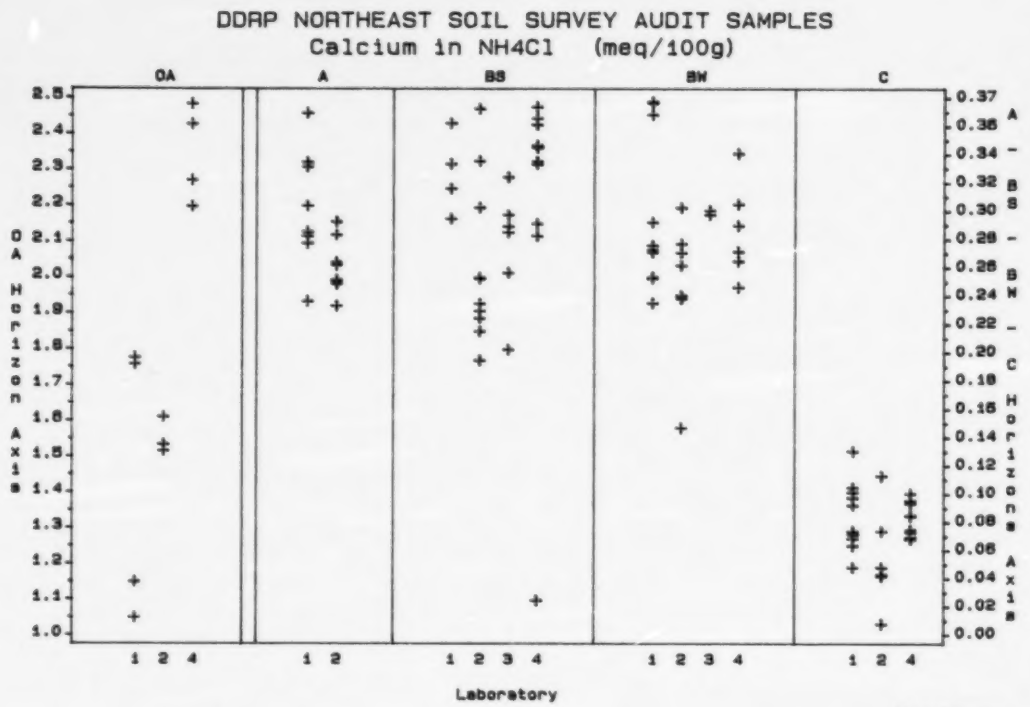
DDRP NORTHEAST SOIL SURVEY AUDIT SAMPLES
Sodium in 0.002 M CaCl2 (meq/100g)




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.068 | 0.129 | | 0.169 | None | 0.101 |
| A | 0.030 | 0.030 | | | None | 0.000 |
| Bs | 0.015 | 0.017 | 0.012 | 0.017 | 3 < 4 | 0.005 |
| Bw | 0.019 | 0.022 | 0.017 | 0.022 | None | 0.005 |
| C | 0.004 | 0.005 | | 0.005 | None | 0.001 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.042 | 0.199 | 0.075 | 1.34 |
| A | 6 | 0.003 | 0.894 | 0.018 | 0.01 |
| Bs | 11 | 0.002 | 0.027 | 0.011 | 0.46 |
| Bw | 9 | 0.003 | 0.345 | 0.010 | 0.50 |
| C | 11 | 0.001 | 0.483 | 0.009 | 0.09 |

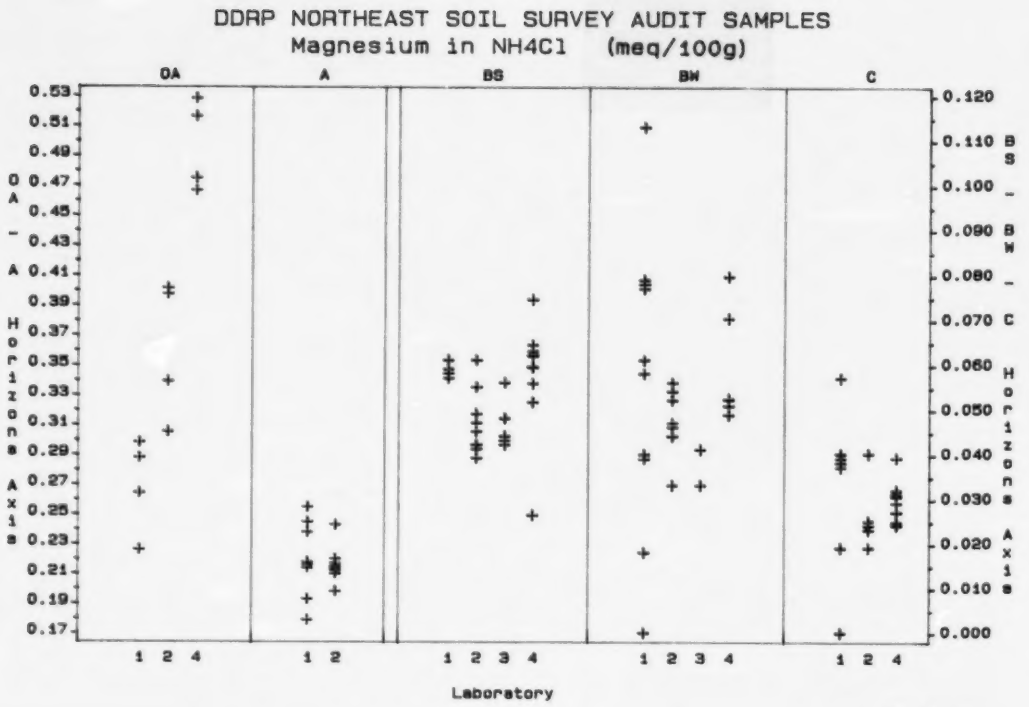
Figure A.30. Interlaboratory difference analysis of sodium in 0.002 M $CaCl_2$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 1.431 | 1.546 | | 2.344 | None | 0.913 |
| A | 0.294 | 0.253 | | | 2 < 1 | 0.041 |
| Bs | 0.317 | 0.254 | 0.268 | 0.297 | None | 0.063 |
| Bw | 0.289 | 0.240 | 0.290 | 0.278 | None | 0.051 |
| C | 0.082 | 0.052 | | 0.078 | None | 0.030 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values — Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.287 | 0.090 | 5.299 | 0.17 |
| A | 6 | 0.017 | 0.013 | 1.627 | 0.03 |
| Bs | 11 | 0.053 | 0.442 | 0.264 | 0.24 |
| Bw | 9 | 0.043 | 0.409 | 0.310 | 0.16 |
| C | 11 | 0.018 | 0.102 | 0.642 | 0.05 |

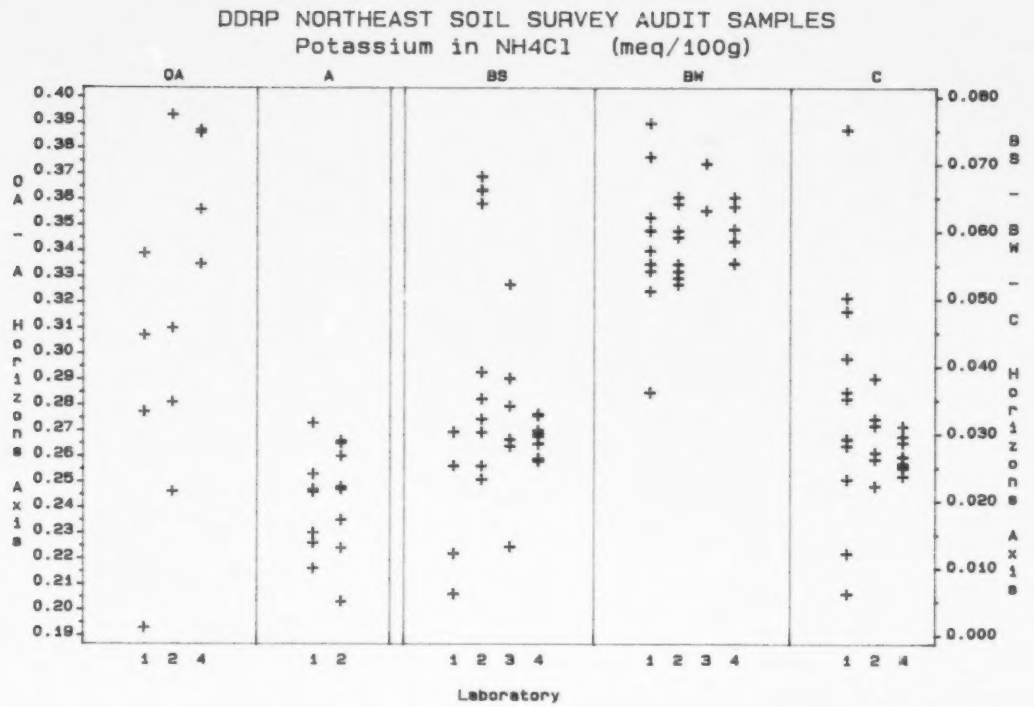
Figure A.31. Interlaboratory difference analysis of calcium in $NH_4Cl$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.269 | 0.360 | | 0.497 | 1 < 4 | 0.228 |
| A | 0.220 | 0.216 | | | None | 0.004 |
| Bs | 0.059 | 0.046 | 0.046 | 0.058 | None | 0.013 |
| Bw | 0.056 | 0.047 | 0.037 | 0.059 | None | 0.022 |
| C | 0.031 | 0.026 | | 0.029 | None | 0.005 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.039 | 0.023 | 0.877 | 0.26 |
| A | 6 | 0.012 | 0.676 | 0.238 | 0.02 |
| Bs | 11 | 0.007 | 0.060 | 0.037 | 0.34 |
| Bw | 9 | 0.023 | 0.789 | 0.036 | 0.62 |
| C | 11 | 0.012 | 0.845 | 0.212 | 0.02 |

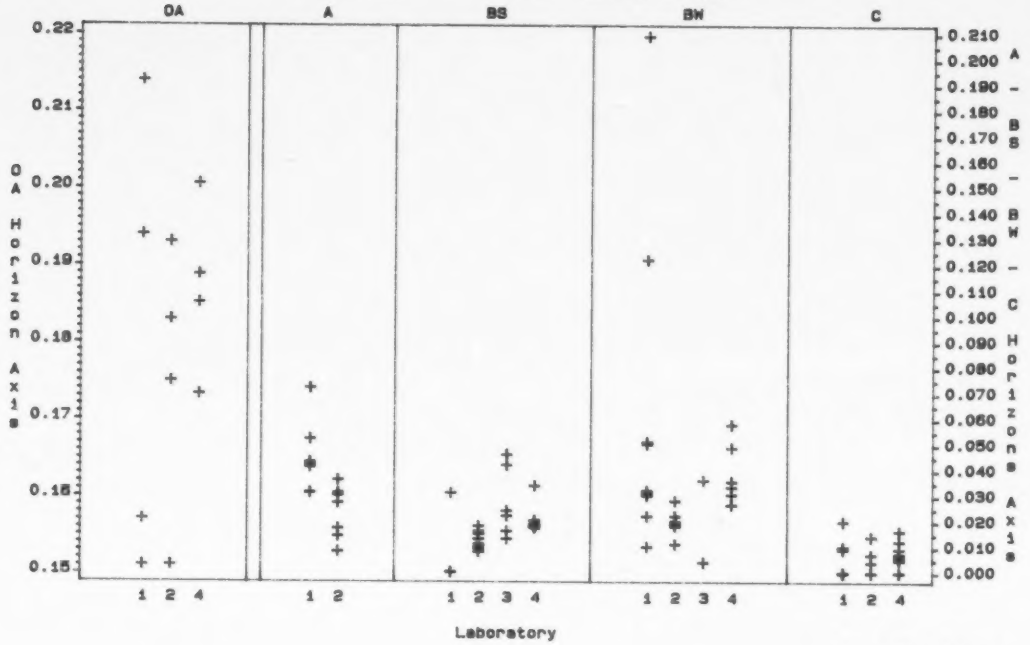
Figure A.32. Interlaboratory difference analysis of magnesium in $NH_4Cl$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.279 | 0.307 | | 0.366 | None | 0.087 |
| A | 0.240 | 0.243 | | | None | 0.004 |
| Bs | 0.018 | 0.045 | 0.032 | 0.029 | None | 0.027 |
| Bw | 0.058 | 0.058 | 0.067 | 0.060 | None | 0.009 |
| C | 0.034 | 0.029 | | 0.027 | None | 0.008 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.041 | 0.245 | 0.439 | 0.20 |
| A | 6 | 0.020 | 0.794 | 0.109 | 0.04 |
| Bs | 11 | 0.014 | 0.146 | 0.026 | 1.00 |
| Bw | 9 | 0.006 | 0.585 | 0.039 | 0.22 |
| C | 11 | 0.012 | 0.574 | 0.032 | 0.24 |

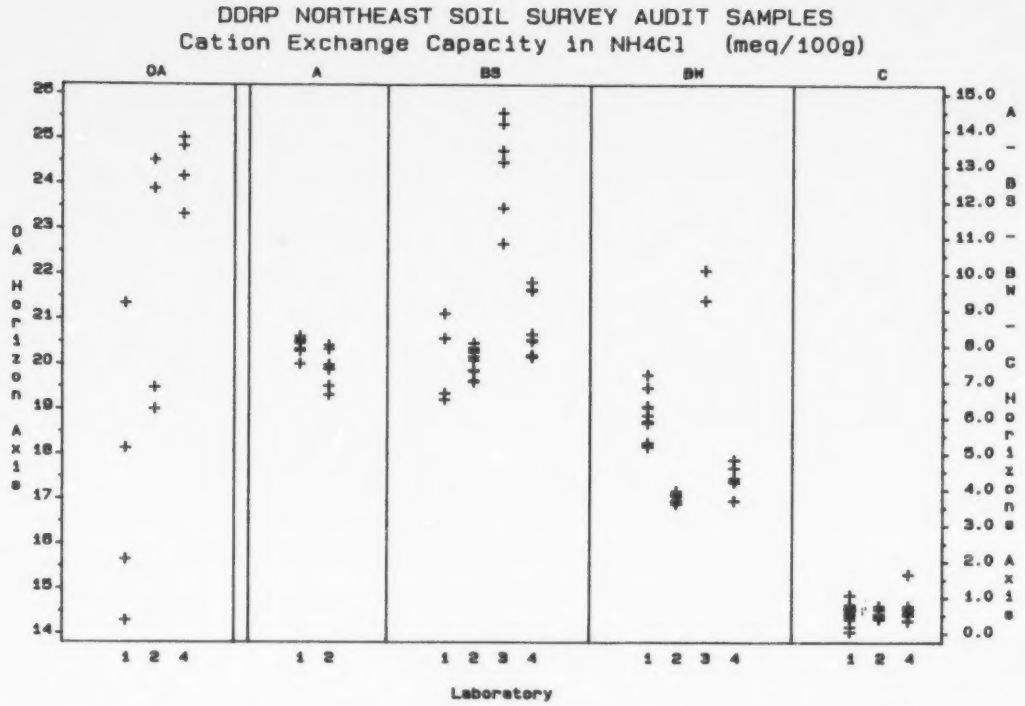
Figure A.33. Interlaboratory difference analysis of potassium in $NH_4Cl$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.179 | 0.175 | | 0.187 | None | 0.011 |
| A | 0.043 | 0.024 | | | 2 < 1 | 0.019 |
| Bs | 0.008 | 0.013 | 0.027 | 0.020 | None | 0.019 |
| Bw | 0.059 | 0.020 | 0.020 | 0.039 | None | 0.039 |
| C | 0.005 | 0.004 | | 0.007 | None | 0.003 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values — Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.022 | 0.869 | 0.115 | 0.10 |
| A | 6 | 0.010 | 0.034 | 0.029 | 0.65 |
| Bs | 11 | 0.008 | 0.055 | 0.015 | 1.32 |
| Bw | 9 | 0.025 | 0.178 | 0.017 | 2.31 |
| C | 11 | 0.004 | 0.652 | 0.018 | 0.15 |

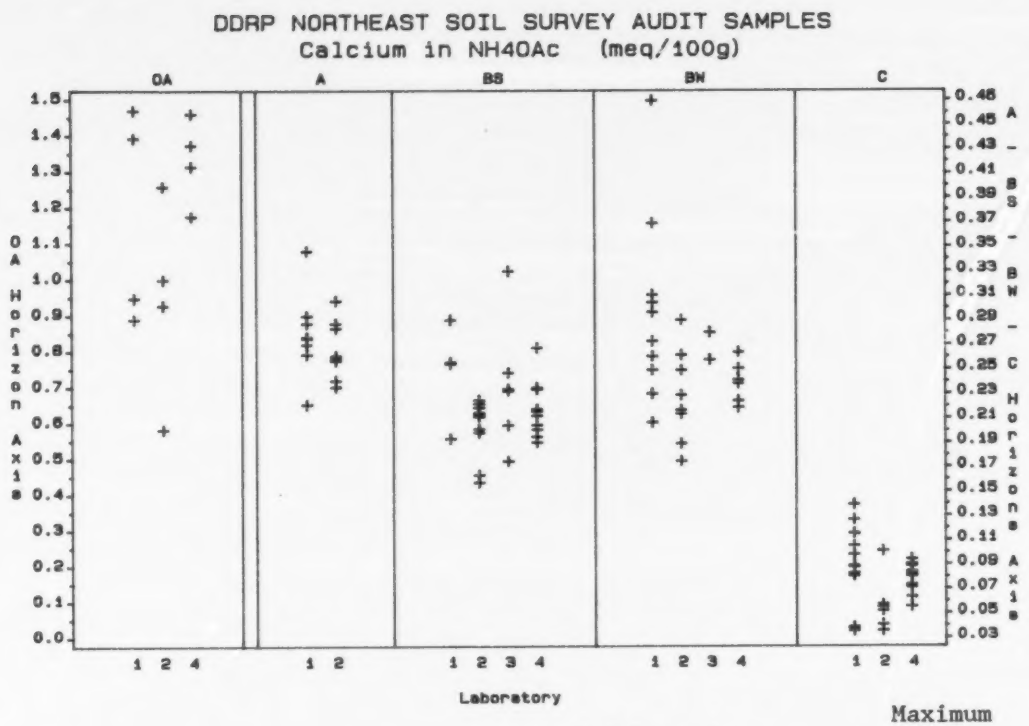
Figure A.34. Interlaboratory difference analysis of sodium in $NH_4Cl$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 17.35 | 21.71 | | 24.34 | None | 6.99 |
| A | 7.97 | 7.33 | | | 2 < 1 | 0.64 |
| Bs | 7.54 | 7.53 | 12.93 | 8.41 | 1,2,4 < 3 | 5.39 |
| Bw | 5.98 | 3.74 | 9.62 | 4.26 | 1,2,4 < 3; 2,4 < 1 | 5.89 |
| C | 0.54 | 0.52 | | 0.63 | None | 0.11 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 2.123 | 0.099 | 8.485 | 0.82 |
| A | 6 | 0.322 | 0.031 | 3.972 | 0.16 |
| Bs | 11 | 0.730 | <0.001 | 3.459 | 1.56 |
| Bw | 9 | 0.411 | <0.001 | 2.109 | 2.79 |
| C | 11 | 0.258 | 0.799 | 1.325 | 0.09 |

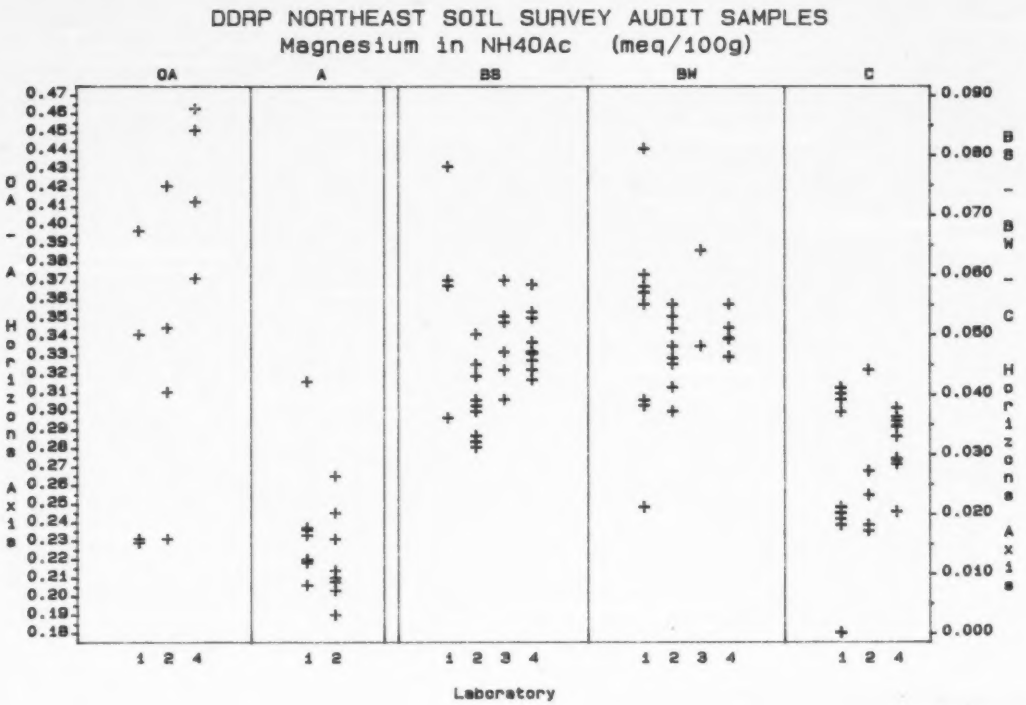
Figure A.35. Interlaboratory difference analysis of cation exchange capacity in $NH_4Cl$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 1.174 | 0.940 | | 1.331 | None | 0.390 |
| A | 0.272 | 0.259 | | | None | 0.013 |
| Bs | 0.242 | 0.197 | 0.231 | 0.212 | None | 0.045 |
| Bw | 0.289 | 0.222 | 0.262 | 0.233 | None | 0.067 |
| C | 0.084 | 0.055 | | 0.076 | None | 0.029 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.269 | 0.448 | 4.673 | 0.08 |
| A | 6 | 0.013 | 0.215 | 1.567 | 0.01 |
| Bs | 11 | 0.023 | 0.118 | 0.195 | 0.23 |
| Bw | 9 | 0.053 | 0.308 | 0.337 | 0.20 |
| C | 11 | 0.019 | 0.158 | 0.592 | 0.05 |

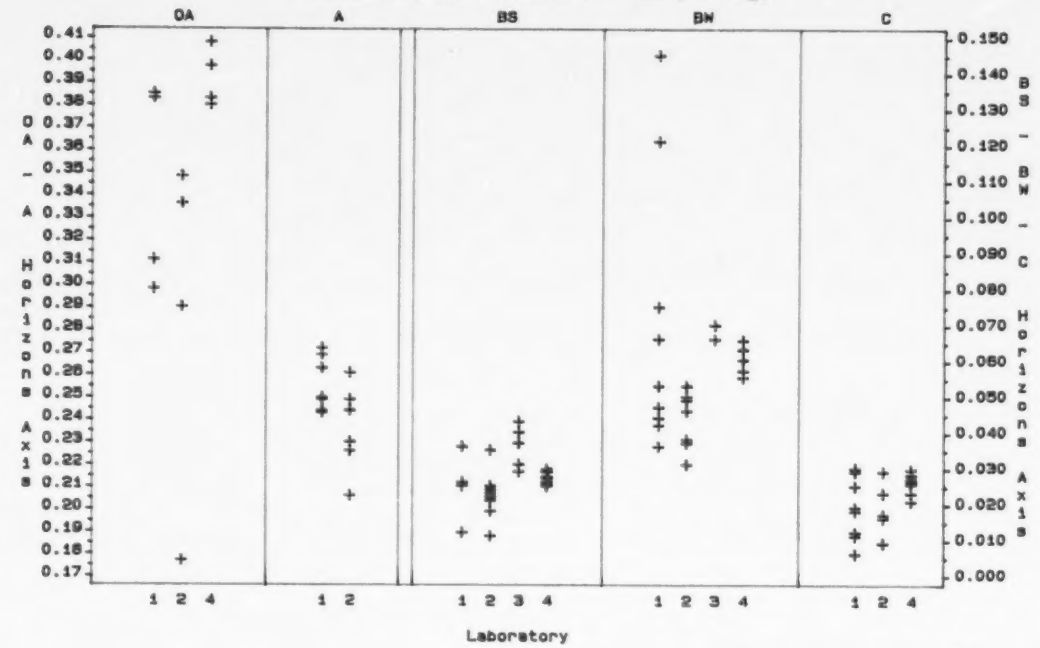
Figure A.36. Interlaboratory difference analysis of calcium in $NH_4OAc$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.299 | 0.327 | | 0.425 | None | 0.125 |
| A | 0.236 | 0.221 | | | None | 0.015 |
| Bs | 0.058 | 0.039 | 0.049 | 0.049 | 2 < 1 | 0.019 |
| Bw | 0.050 | 0.047 | 0.056 | 0.050 | None | 0.009 |
| C | 0.025 | 0.026 | | 0.032 | None | 0.007 |

| Audit sample ANOVA summary Ho: No differences among laboratories' reported values | | | | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Horizon | Error DF | Standard deviation | Significance level | | |
| Oa | 3 | 0.070 | 0.312 | 0.906 | 0.14 |
| A | 6 | 0.024 | 0.410 | 0.223 | 0.07 |
| Bs | 11 | 0.006 | 0.008 | 0.030 | 0.63 |
| Bw | 9 | 0.005 | 0.421 | 0.038 | 0.24 |
| C | 11 | 0.010 | 0.516 | 0.195 | 0.04 |

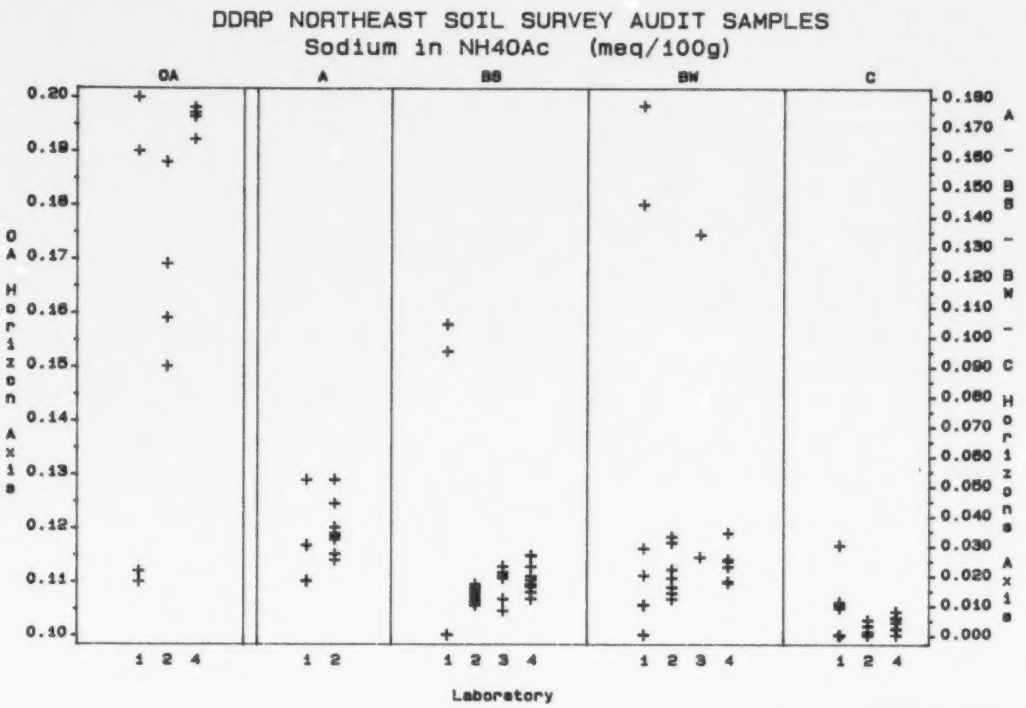
Figure A.37. Interlaboratory difference analysis of magnesium in $NH_4OAc$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.344 | 0.288 | | 0.392 | None | 0.105 |
| A | 0.257 | 0.236 | | | 2 < 1 | 0.020 |
| Bs | 0.025 | 0.022 | 0.036 | 0.027 | 1,2,4 < 3 | 0.014 |
| Bw | 0.069 | 0.045 | 0.068 | 0.061 | None | 0.025 |
| C | 0.018 | 0.017 | | 0.026 | None | 0.009 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.056 | 0.310 | 0.436 | 0.24 |
| A | 6 | 0.009 | 0.017 | 0.096 | 0.21 |
| Bs | 11 | 0.004 | 0.003 | 0.030 | 0.46 |
| Bw | 9 | 0.025 | 0.540 | 0.035 | 0.72 |
| C | 11 | 0.006 | 0.103 | 0.026 | 0.34 |

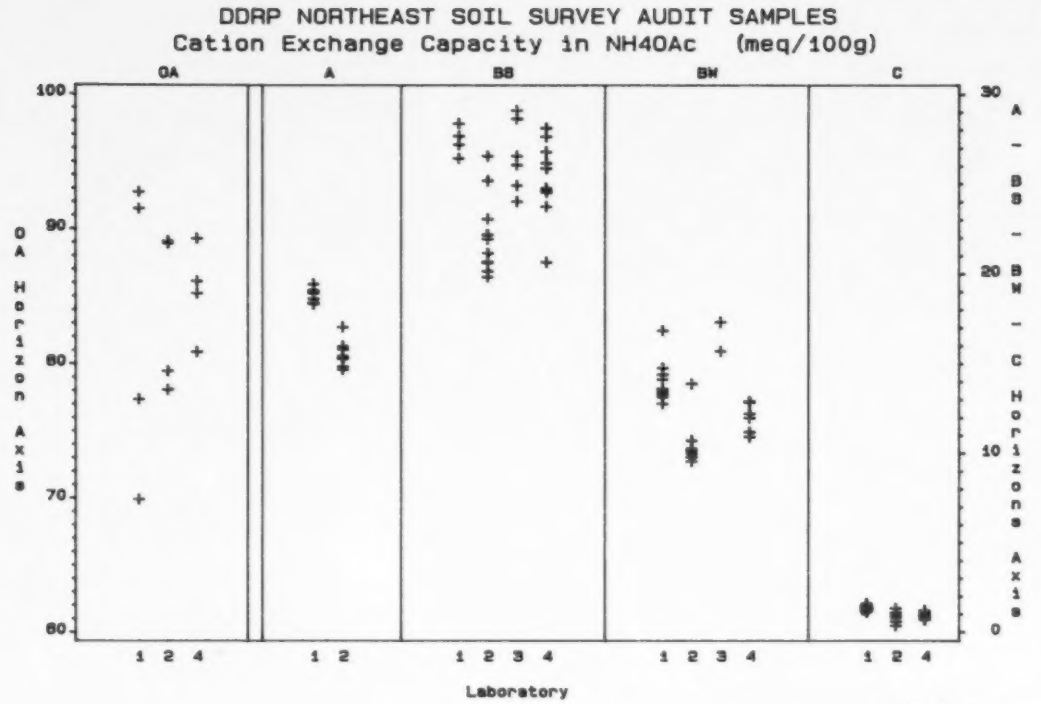
Figure A.38. Interlaboratory difference analysis of potassium in $NH_4OAc$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.153 | 0.166 | | 0.196 | None | 0.043 |
| A | 0.027 | 0.035 | | | None | 0.009 |
| Bs | 0.050 | 0.013 | 0.017 | 0.019 | None | 0.037 |
| Bw | 0.041 | 0.020 | 0.080 | 0.024 | None | 0.060 |
| C | 0.007 | 0.002 | | 0.004 | None | 0.005 |

| Audit sample ANOVA summary Ho: No differences among laboratories' reported values | | | | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Horizon | Error DF | Standard deviation | Significance level | | |
| Oa | 3 | 0.034 | 0.520 | 0.118 | 0.36 |
| A | 6 | 0.009 | 0.209 | 0.032 | 0.27 |
| Bs | 11 | 0.021 | 0.277 | 0.017 | 2.21 |
| Bw | 9 | 0.045 | 0.653 | 0.024 | 2.51 |
| C | 11 | 0.005 | 0.420 | 0.018 | 0.27 |

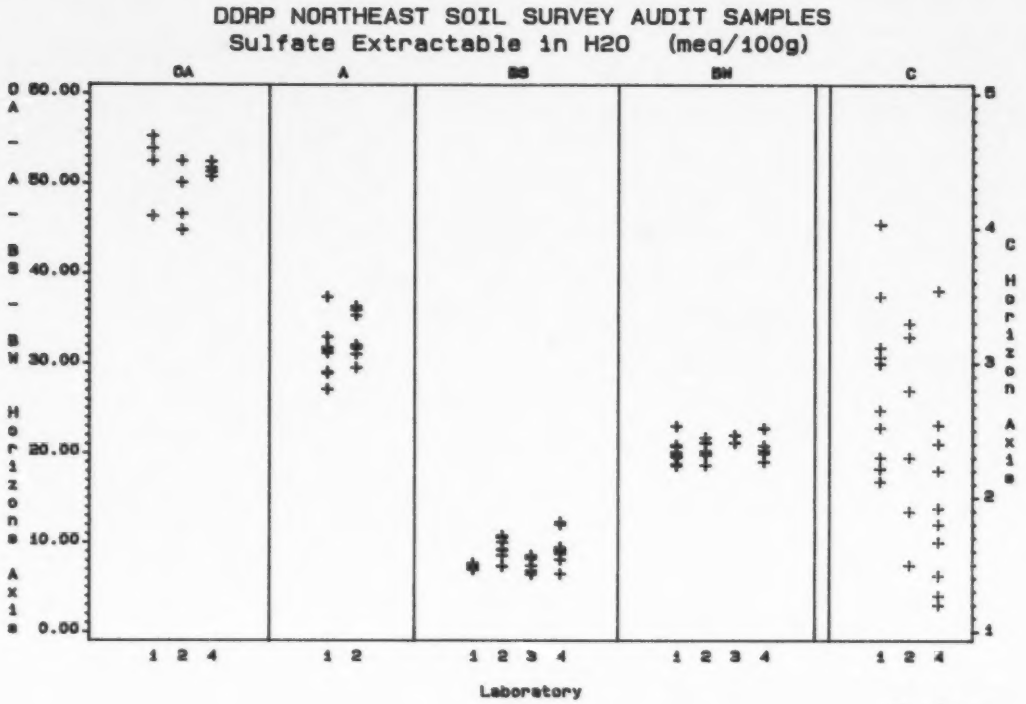
Figure A.39. Interlaboratory difference analysis of sodium in $NH_4OAc$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 82.84 | 83.85 | | 85.36 | None | 2.52 |
| A | 18.67 | 15.43 | | | 2 < 1 | 3.24 |
| Bs | 27.33 | 22.05 | 26.47 | 25.21 | None | 5.28 |
| Bw | 13.88 | 10.40 | 16.38 | 11.89 | 2 < 1,3; 4 < 3 | 5.99 |
| C | 1.26 | 0.76 | | 0.85 | 2,4 < 1 | 0.50 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values — Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 8.843 | 0.960 | 26.916 | 0.09 |
| A | 6 | 0.507 | <0.001 | 7.854 | 0.41 |
| Bs | 11 | 1.959 | 0.018 | 8.596 | 0.62 |
| Bw | 9 | 0.956 | 0.001 | 4.363 | 1.37 |
| C | 11 | 0.194 | 0.005 | 2.131 | 0.24 |

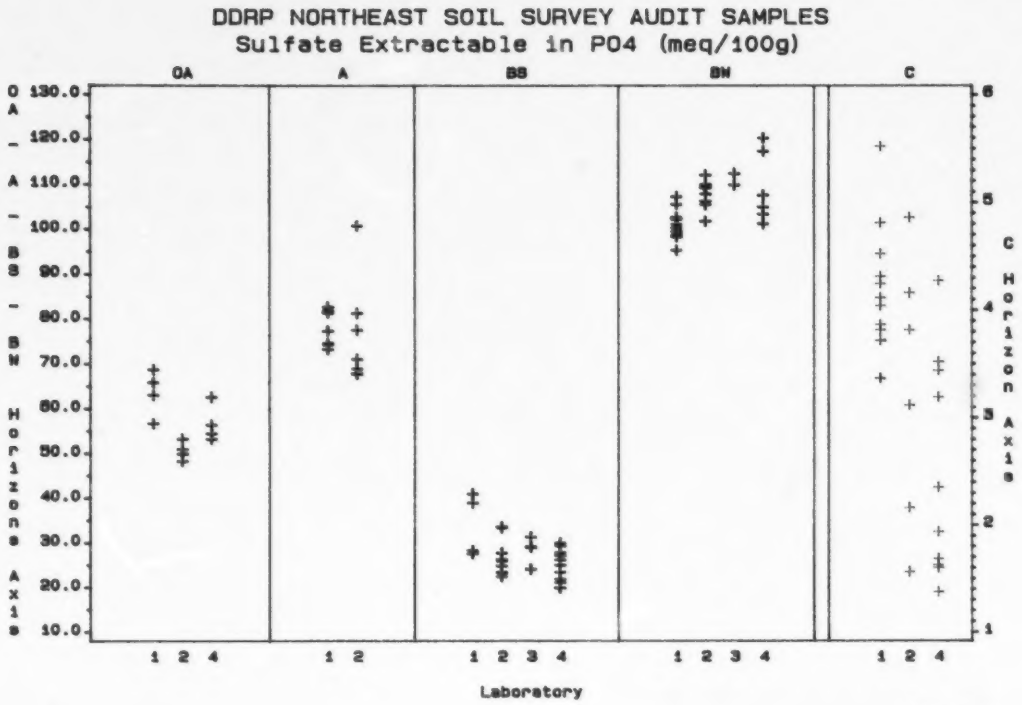
Figure A.40. Interlaboratory difference analysis of cation exchange capacity in $NH_4OAc$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 52.01 | 48.50 | | 51.56 | None | 3.51 |
| A | 31.14 | 32.89 | | | None | 1.75 |
| Bs | 7.25 | 9.22 | 7.57 | 9.28 | None | 2.03 |
| Bw | 20.08 | 20.30 | 21.55 | 20.94 | None | 1.47 |
| C | 2.81 | 2.50 | | 2.00 | None | 0.81 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 2.752 | 0.475 | 16.744 | 0.21 |
| A | 6 | 2.504 | 0.361 | 6.875 | 0.25 |
| Bs | 11 | 1.222 | 0.156 | 3.233 | 0.63 |
| Bw | 9 | 1.108 | 0.560 | 4.693 | 0.31 |
| C | 11 | 0.539 | 0.085 | 3.846 | 0.21 |

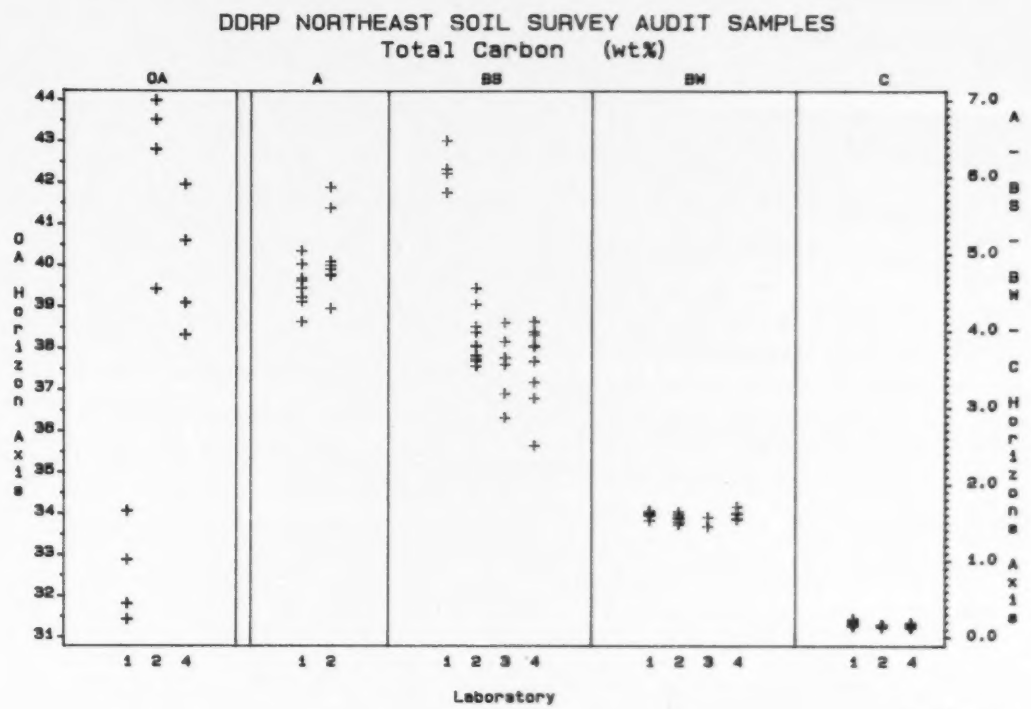
Figure A.41. Interlaboratory difference analysis of sulfate in $H_2O$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 63.4 | 50.4 | | 56.5 | None | 13.0 |
| A | 78.3 | 75.3 | | | None | 3.0 |
| Bs | 33.8 | 26.8 | 27.7 | 25.1 | None | 8.7 |
| Bw | 101.1 | 107.8 | 111.1 | 109.1 | None | 10.0 |
| C | 4.1 | 3.3 | | 2.5 | 4 < 1 | 1.6 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 3.401 | 0.071 | 15.892 | 0.82 |
| A | 6 | 5.221 | 0.444 | 18.396 | 0.16 |
| Bs | 11 | 4.177 | 0.155 | 35.056 | 0.25 |
| Bw | 9 | 4.782 | 0.104 | 30.138 | 0.33 |
| C | 11 | 0.896 | 0.036 | 12.221 | 0.13 |

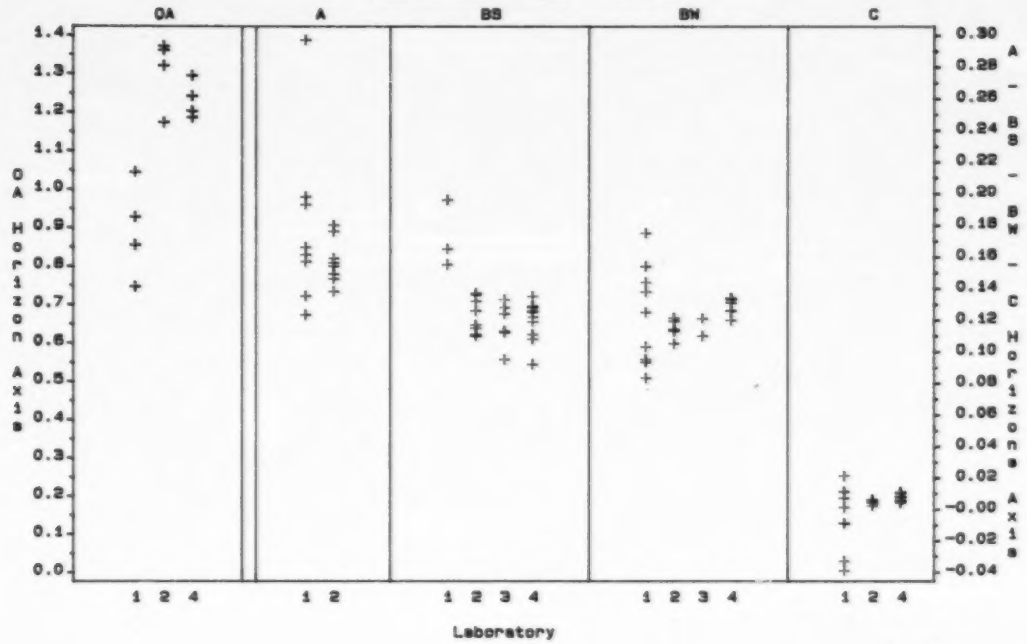
Figure A.42. Interlaboratory difference analysis of sulfate in $PO_4$.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 32.54 | 42.43 | | 39.99 | 1 < 2,4 | 9.89 |
| A | 4.57 | 4.95 | | | None | 0.38 |
| Bs | 6.08 | 3.88 | 3.51 | 3.58 | 2,3,4 < 1 | 2.57 |
| Bw | 1.58 | 1.53 | 1.48 | 1.57 | None | 0.10 |
| C | 0.16 | 0.13 | | 0.13 | None | 0.03 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values — Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 1.322 | 0.010 | 10.123 | 0.98 |
| A | 6 | 0.405 | 0.232 | 2.549 | 0.15 |
| Bs | 11 | 0.323 | <0.001 | 1.680 | 1.53 |
| Bw | 9 | 0.044 | 0.199 | 1.011 | 0.10 |
| C | 11 | 0.022 | 0.046 | 0.189 | 0.18 |

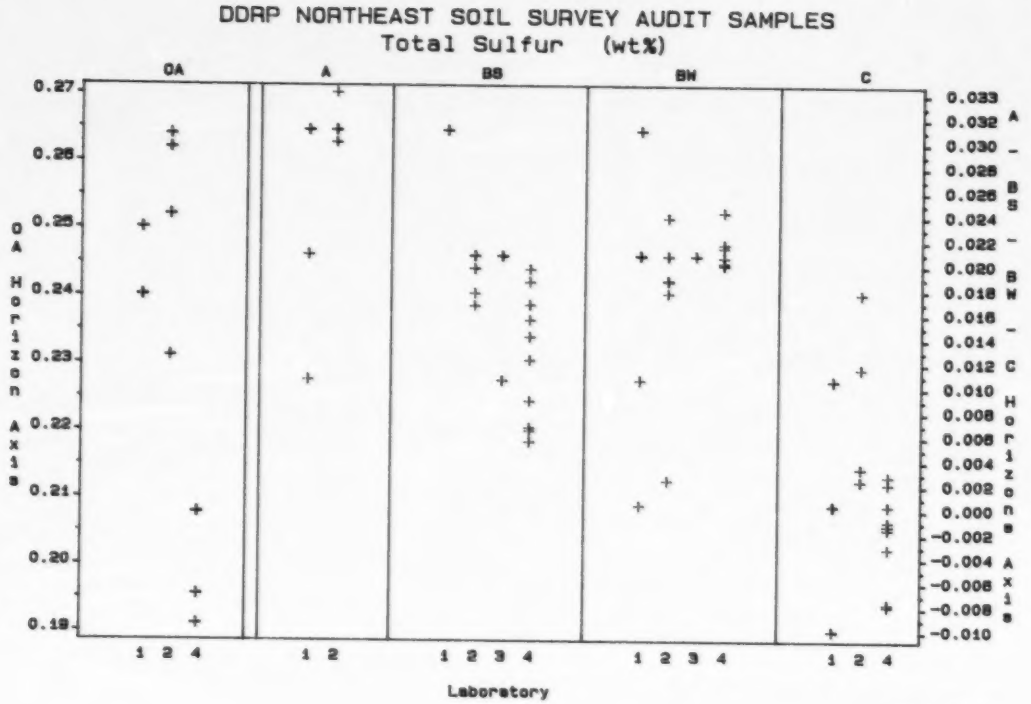
Figure A.43. Interlaboratory difference analysis of total carbon.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.892 | 1.307 | | 1.231 | 1 < 4 | 0.415 |
| A | 0.178 | 0.156 | | | None | 0.022 |
| Bs | 0.177 | 0.119 | 0.116 | 0.118 | 2,3,4 < 1 | 0.061 |
| Bw | 0.125 | 0.113 | 0.114 | 0.127 | None | 0.014 |
| C | -.005 | 0.003 | | 0.006 | None | 0.011 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.092 | 0.039 | 0.426 | 0.97 |
| A | 6 | 0.027 | 0.307 | 0.138 | 0.16 |
| Bs | 11 | 0.008 | <0.001 | 0.080 | 0.75 |
| Bw | 9 | 0.019 | 0.720 | 0.048 | 0.29 |
| C | 11 | 0.009 | 0.185 | 0.023 | 0.48 |

Figure A.44. Interlaboratory difference analysis of total nitrogen.

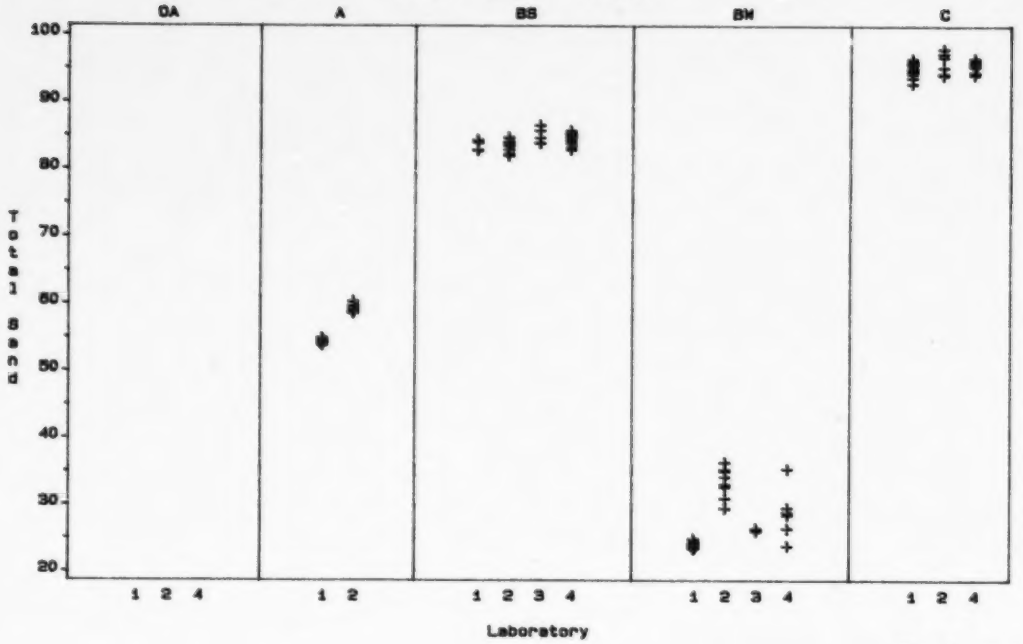



| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 0.242 | 0.252 | | 0.201 | 4 < 1,2 | 0.052 |
| A | 0.024 | 0.030 | | | None | 0.006 |
| Bs | 0.030 | 0.019 | 0.017 | 0.012 | 2,3,4 < 1 | 0.018 |
| Bw | 0.020 | 0.017 | 0.020 | 0.021 | None | 0.004 |
| C | 0.002 | 0.006 | | -.002 | None | 0.008 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.007 | 0.012 | 0.053 | 0.98 |
| A | 6 | 0.005 | 0.092 | 0.017 | 0.37 |
| Bs | 11 | 0.003 | 0.001 | 0.017 | 1.71 |
| Bw | 9 | 0.004 | 0.595 | 0.011 | 0.51 |
| C | 11 | 0.005 | 0.110 | 0.006 | 1.33 |

Figure A.45. Interlaboratory difference analysis of total sulfur.

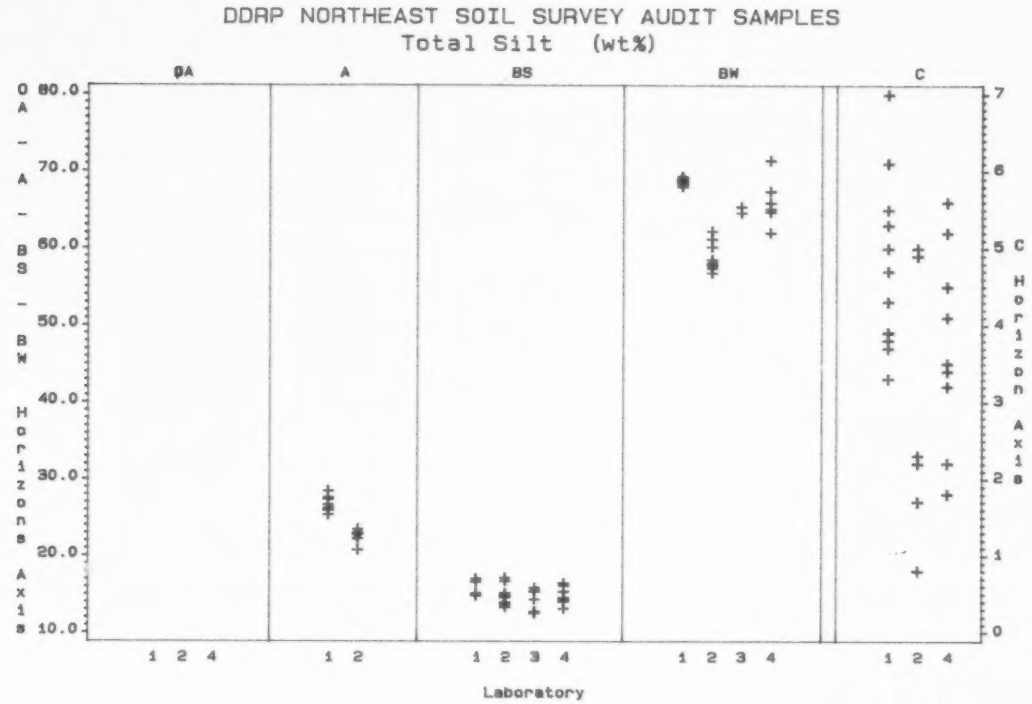
DDRP NORTHEAST SOIL SURVEY AUDIT SAMPLES
Total Sand (wt%)




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 54.39 | 59.19 | | | 1 < 2 | 4.80 |
| Bs | 83.42 | 83.45 | 84.73 | 84.50 | None | 1.31 |
| Bw | 23.96 | 33.31 | 26.20 | 28.70 | 1,3,4 < 2; 1 < 4 | 9.35 |
| C | 95.11 | 95.95 | | 95.64 | None | 0.84 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | . | . | . | . |
| A | 6 | 0.336 | <0.001 | 11.622 | 0.41 |
| Bs | 11 | 0.857 | 0.138 | 10.395 | 0.13 |
| Bw | 9 | 0.748 | <0.001 | 11.953 | 0.78 |
| C | 11 | 0.904 | 0.403 | 12.844 | 0.07 |

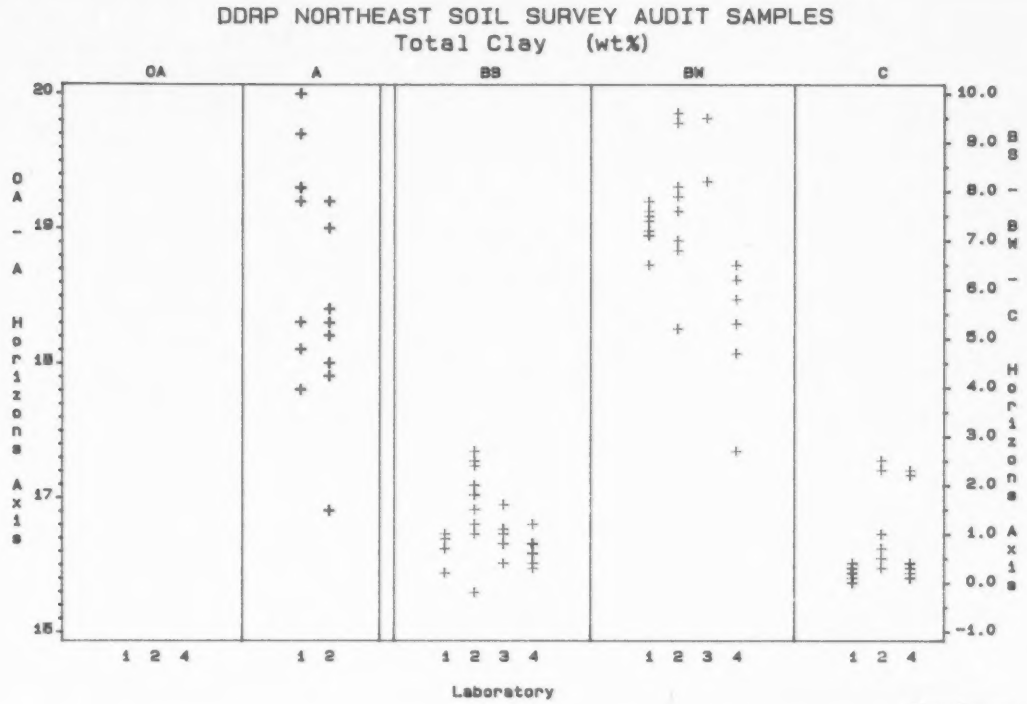
Figure A.46. Interlaboratory difference analysis of total sand.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 26.65 | 22.56 | | | 2 < 1 | 4.09 |
| Bs | 15.88 | 14.85 | 14.33 | 14.77 | None | 1.54 |
| Bw | 68.76 | 59.02 | 65.00 | 66.08 | 2 < 3,4 <1 | 9.74 |
| C | 4.71 | 2.82 | | 3.80 | None | 1.89 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | . | . | . | . |
| A | 6 | 0.820 | <0.001 | 9.991 | 0.41 |
| Bs | 11 | 1.015 | 0.450 | 8.579 | 0.18 |
| Bw | 9 | 0.587 | <0.001 | 10.157 | 0.96 |
| C | 11 | 1.114 | 0.092 | 11.046 | 0.17 |

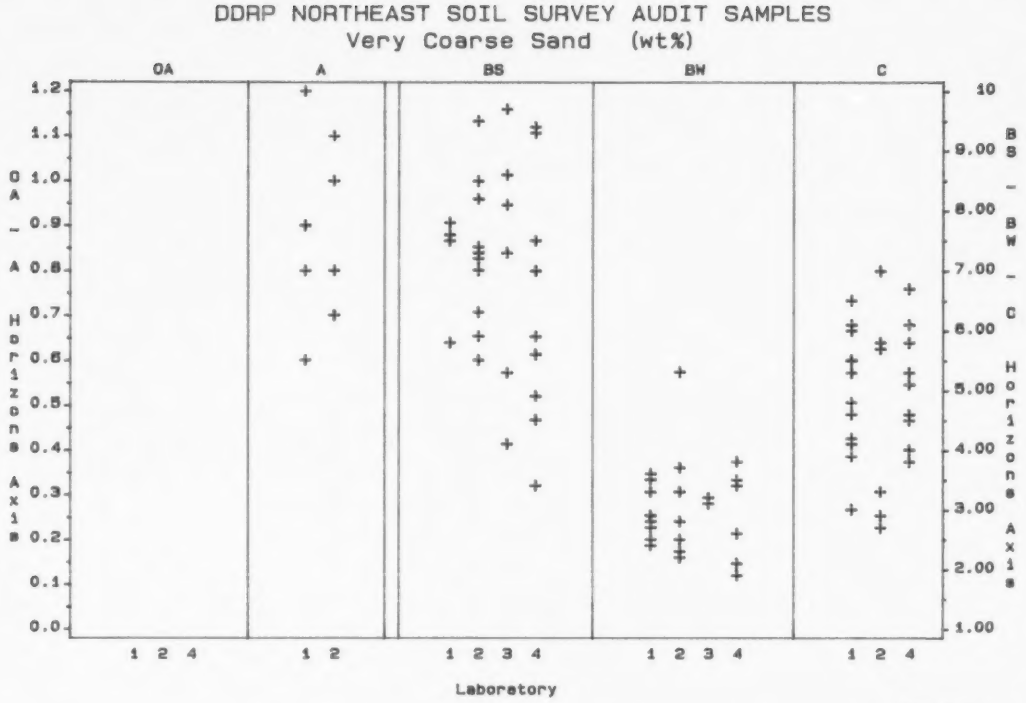
Figure A.47. Interlaboratory difference analysis of total silt.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 18.96 | 18.24 | | | None | 0.73 |
| Bs | 0.70 | 1.69 | 0.95 | 0.71 | 1,3,4 < 2 | 0.99 |
| Bw | 7.27 | 7.70 | 8.85 | 5.20 | None | 3.65 |
| C | 0.17 | 1.22 | | 0.67 | None | 1.05 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | . | . | . | . |
| A | 6 | 0.677 | 0.181 | 3.643 | 0.20 |
| Bs | 11 | 0.294 | 0.001 | 2.126 | 0.47 |
| Bw | 9 | 0.987 | 0.022 | 3.257 | 1.12 |
| C | 11 | 0.703 | 0.146 | 2.423 | 0.43 |

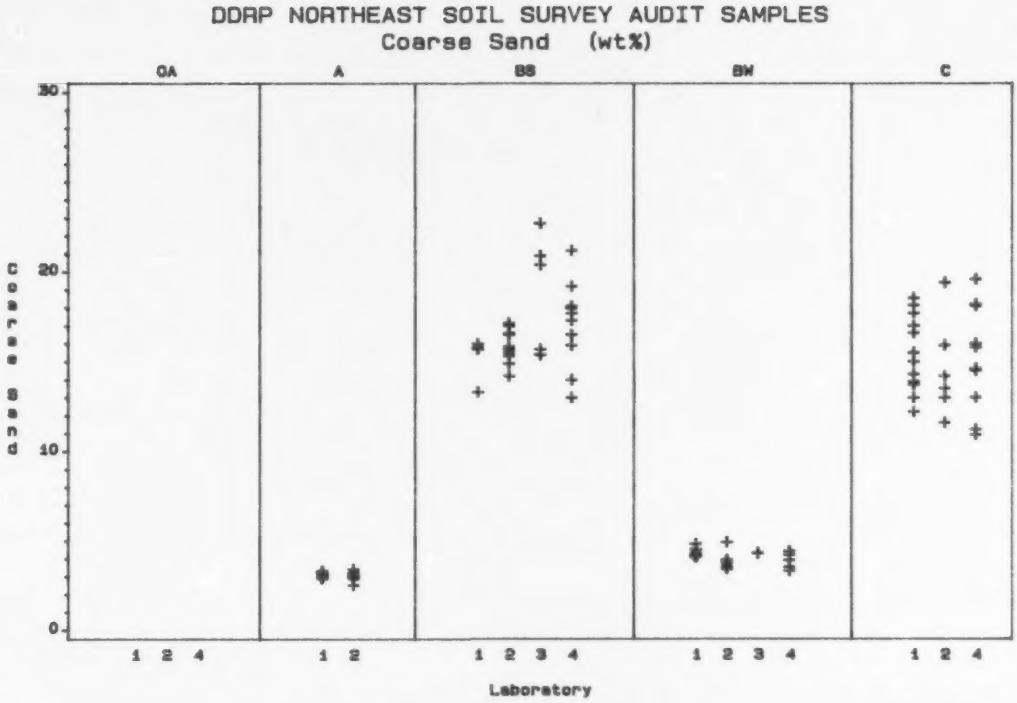
Figure A.48. Interlaboratory difference analysis of clay.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 0.84 | 0.85 | | | None | 0.01 |
| Bs | 7.17 | 7.28 | 7.18 | 6.45 | None | 0.83 |
| Bw | 2.95 | 3.17 | 3.15 | 2.88 | None | 0.29 |
| C | 4.96 | 4.57 | | 5.20 | None | 0.63 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | . | . | . | . |
| A | 6 | 0.067 | 0.801 | 2.183 | 0.01 |
| Bs | 11 | 1.347 | 0.771 | 3.496 | 0.24 |
| Bw | 9 | 0.598 | 0.907 | 2.425 | 0.12 |
| C | 11 | 1.011 | 0.700 | 4.103 | 0.15 |

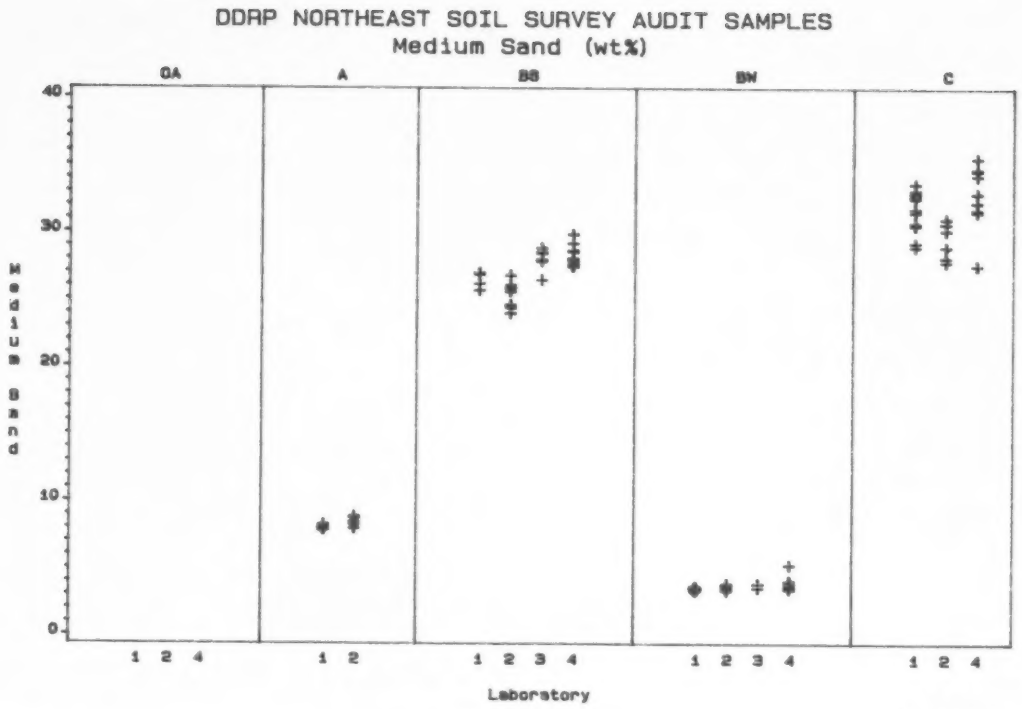
Figure A.49. Interlaboratory difference analysis of very coarse sand.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 3.10 | 3.04 | | | None | 0.06 |
| Bs | 15.20 | 15.86 | 18.42 | 17.09 | None | 3.22 |
| Bw | 4.30 | 3.82 | 4.30 | 3.95 | None | 0.48 |
| C | 15.46 | 14.60 | | 15.19 | None | 0.86 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | . | . | . | . |
| A | 6 | 0.176 | 0.634 | 3.364 | 0.02 |
| Bs | 11 | 1.782 | 0.196 | 3.075 | 1.05 |
| Bw | 9 | 0.270 | 0.105 | 3.655 | 0.13 |
| C | 11 | 2.102 | 0.848 | 5.606 | 0.15 |

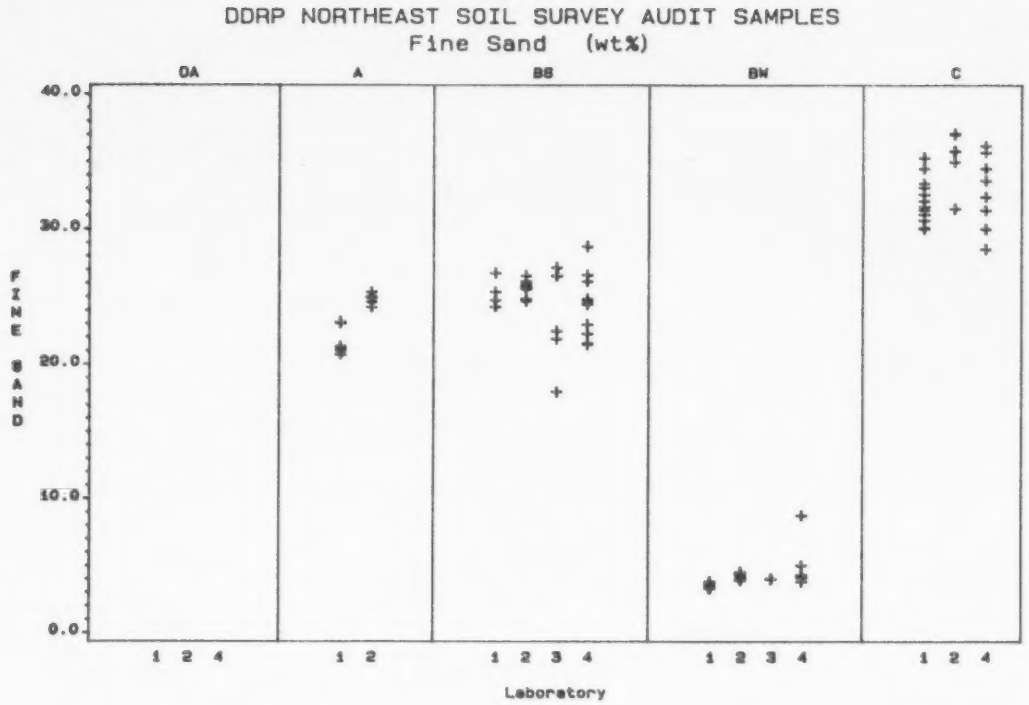
Figure A.50. Interlaboratory difference analysis of coarse sand.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 7.95 | 8.39 | | | 1 < 2 | 0.44 |
| Bs | 26.35 | 25.25 | 27.97 | 28.17 | 1 < 4; 2 < 3,4 | 2.92 |
| Bw | 3.46 | 3.60 | 3.65 | 3.92 | None | 0.46 |
| C | 31.68 | 29.42 | | 32.77 | 2 < 4 | 3.35 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | . | . | . | . |
| A | 6 | 0.192 | 0.018 | 4.276 | 0.10 |
| Bs | 11 | 0.565 | <0.001 | 3.765 | 0.78 |
| Bw | 9 | 0.200 | 0.072 | 4.221 | 0.11 |
| C | 11 | 1.180 | 0.008 | 5.743 | 0.58 |

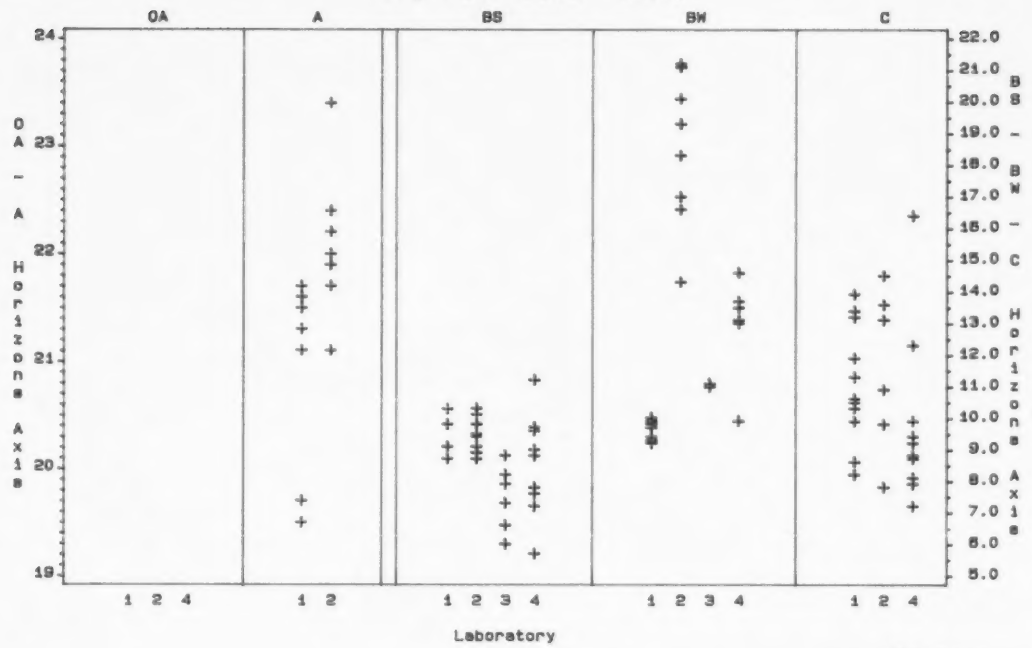
Figure A.51. Interlaboratory difference analysis of medium sand.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 21.50 | 24.86 | | | 1 < 2 | 3.36 |
| Bs | 25.22 | 25.62 | 23.70 | 24.32 | None | 1.92 |
| Bw | 3.57 | 4.20 | 4.00 | 5.02 | None | 1.45 |
| C | 32.16 | 35.37 | | 32.68 | None | 3.21 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | . | . | . | . |
| A | 6 | 0.451 | <0.001 | 5.208 | 0.65 |
| Bs | 11 | 1.770 | 0.472 | 5.284 | 0.36 |
| Bw | 9 | 0.763 | 0.149 | 5.354 | 0.27 |
| C | 11 | 1.667 | 0.053 | 6.054 | 0.53 |

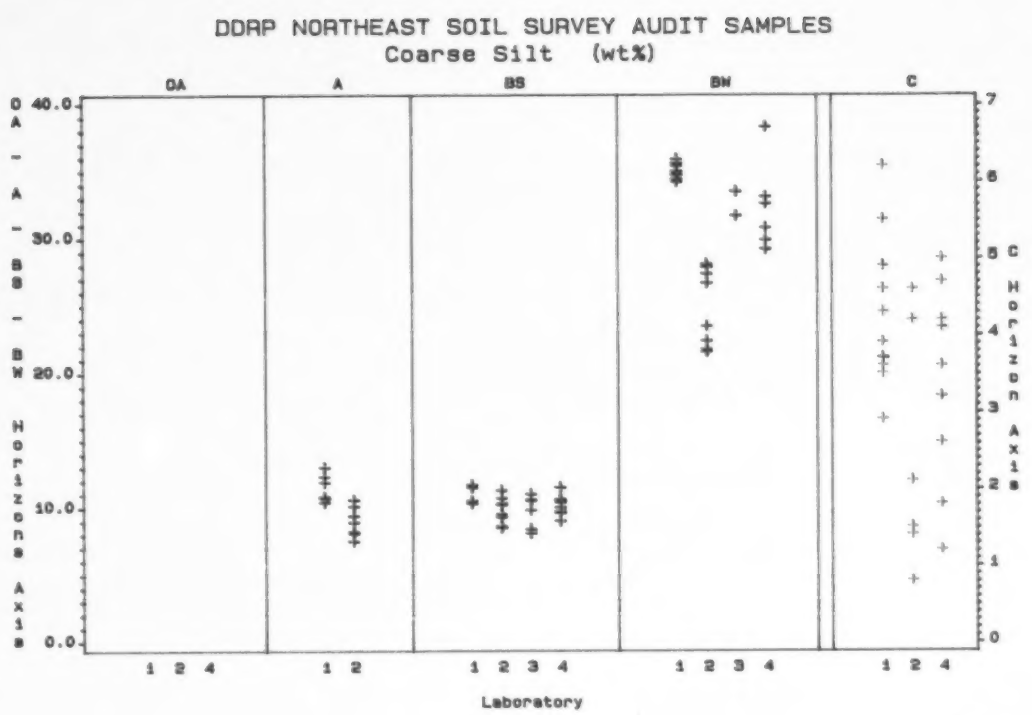
Figure A.52. Interlaboratory difference analysis of fine sand.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 21.00 | 22.07 | | | 1 < 2 | 1.08 |
| Bs | 9.47 | 9.45 | 7.47 | 8.44 | None | 2.01 |
| Bw | 9.69 | 18.49 | 11.05 | 12.97 | 1,3,4 < 2; 1 < 4 | 8.80 |
| C | 10.83 | 11.62 | | 9.79 | None | 1.83 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | . | . | . | . |
| A | 6 | 0.518 | 0.026 | 3.719 | 0.29 |
| Bs | 11 | 1.021 | 0.086 | 4.021 | 0.50 |
| Bw | 9 | 1.225 | <0.001 | 3.989 | 2.21 |
| C | 11 | 1.986 | 0.454 | 4.955 | 0.37 |

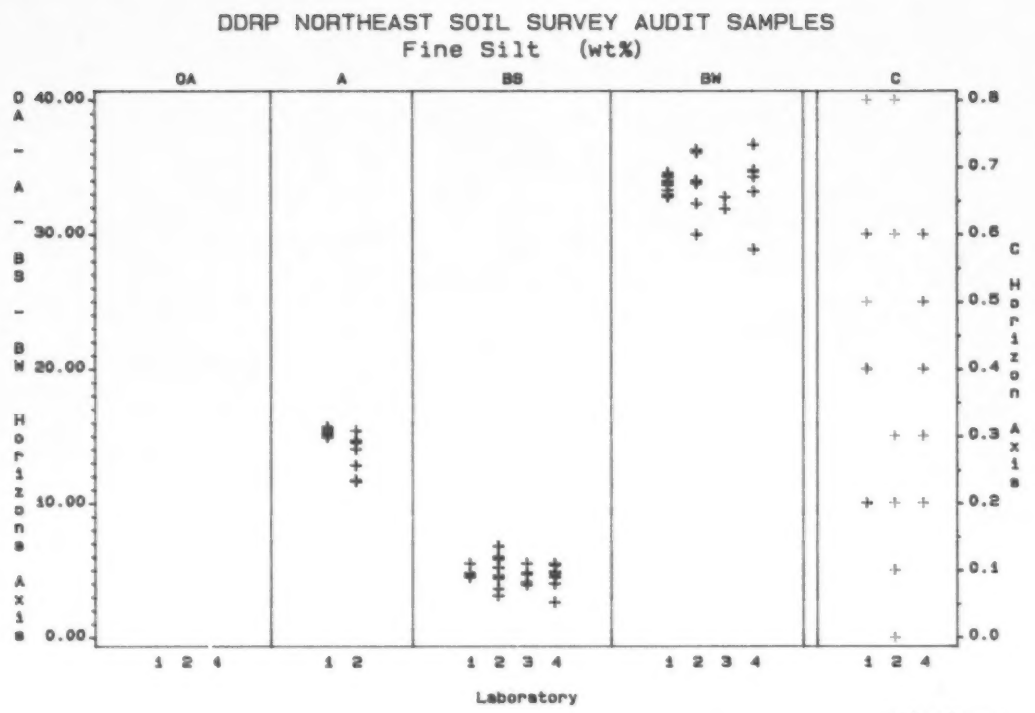
Figure A.53. Interlaboratory difference analysis of very fine sand.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 11.32 | 8.87 | | | 2 < 1 | 2.45 |
| Bs | 11.00 | 9.79 | 9.73 | 10.24 | None | 1.27 |
| Bw | 34.97 | 24.92 | 32.60 | 32.32 | 2 < 1,3,4 | 10.05 |
| C | 4.31 | 2.43 | | 3.36 | None | 1.88 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling-class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | . | . | . | . |
| A | 6 | 1.011 | 0.014 | 4.333 | 0.57 |
| Bs | 11 | 0.666 | 0.180 | 5.060 | 0.25 |
| Bw | 9 | 1.955 | <0.001 | 5.358 | 1.87 |
| C | 11 | 1.043 | 0.071 | 5.648 | 0.33 |

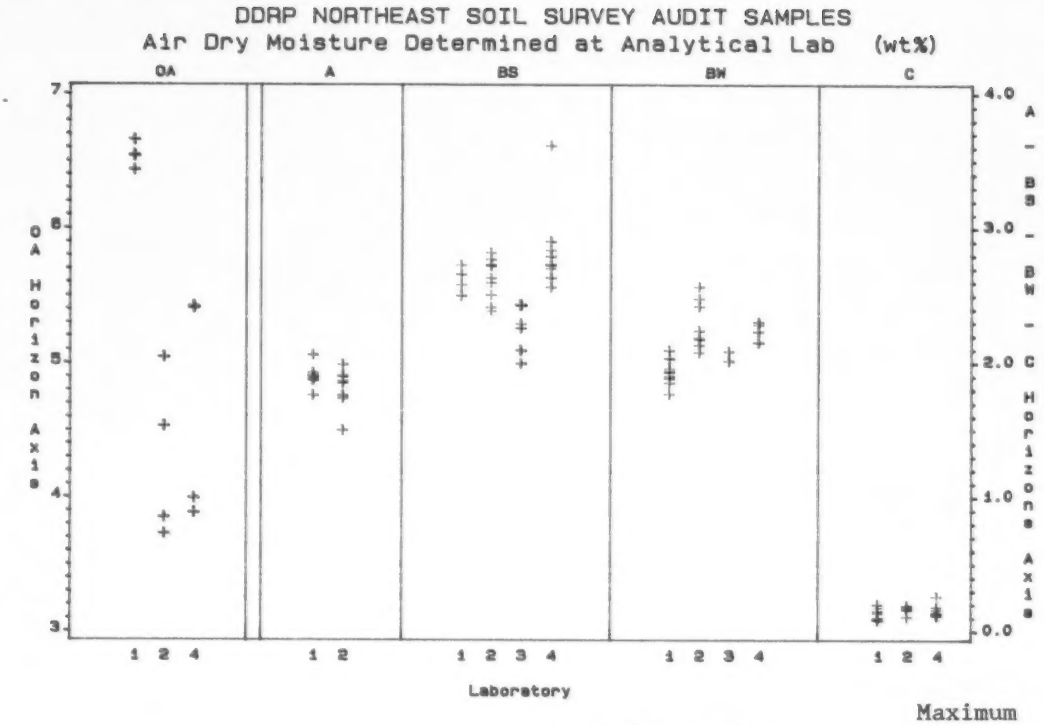
Figure A.54. Interlaboratory difference analysis of coarse silt.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 15.30 | 13.66 | | | 2 < 1 | 1.64 |
| Bs | 4.85 | 5.07 | 4.62 | 4.52 | None | 0.55 |
| Bw | 33.77 | 34.07 | 32.35 | 33.77 | None | 1.73 |
| C | 0.41 | 0.33 | | 0.44 | None | 0.11 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | . | . | . | . |
| A | 6 | 0.888 | 0.040 | 6.128 | 0.27 |
| Bs | 11 | 0.535 | 0.435 | 6.163 | 0.09 |
| Bw | 9 | 1.530 | 0.797 | 5.515 | 0.31 |
| C | 11 | 0.169 | 0.695 | 6.460 | 0.02 |

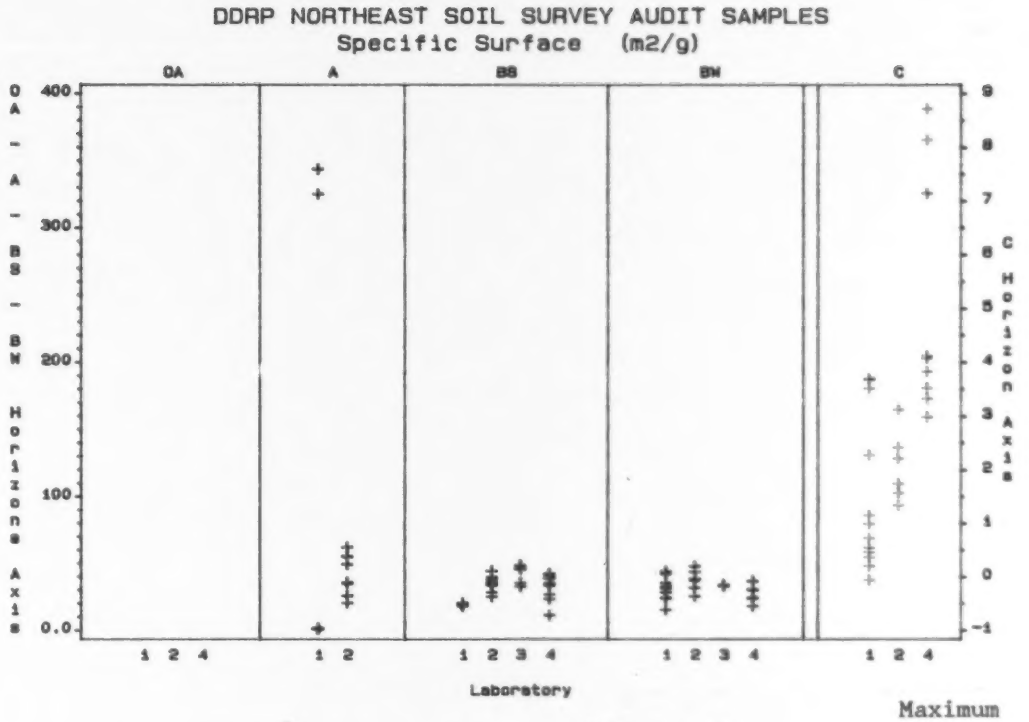
Figure A.55. Interlaboratory difference analysis of fine silt.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | 6.54 | 4.29 | | 4.67 | None | 2.25 |
| A | 1.89 | 1.81 | | | None | 0.09 |
| Bs | 2.61 | 2.63 | 2.25 | 2.83 | 3 < 4 | 0.58 |
| Bw | 1.94 | 2.28 | 2.05 | 2.25 | 1 < 2,4 | 0.35 |
| C | 0.13 | 0.16 | | 0.15 | None | 0.04 |

| Horizon | Audit sample ANOVA summary Ho: No differences among laboratories' reported values: Error DF | Standard deviation | Significance level | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Oa | 3 | 0.610 | 0.065 | 2.109 | 1.07 |
| A | 6 | 0.086 | 0.212 | 1.107 | 0.08 |
| Bs | 11 | 0.173 | 0.007 | 1.222 | 0.47 |
| Bw | 9 | 0.121 | 0.008 | 0.680 | 0.51 |
| C | 11 | 0.032 | 0.192 | 0.322 | 0.12 |

Figure A.56. Interlaboratory difference analysis of moisture.




| Horizon | Means by laboratory 1 | 2 | 3 | 4 | Laboratories that differ significantly (0.05 significance level) | Maximum difference among laboratory means |
|---|---|---|---|---|---|---|
| Oa | . | . | | . | . | . |
| A | 84.55 | 42.31 | | | None | 42.24 |
| Bs | 18.99 | 35.00 | 42.56 | 32.02 | 1 < 3 | 23.57 |
| Bw | 30.51 | 36.75 | 33.54 | 27.17 | None | 9.57 |
| C | 1.43 | 2.04 | | 5.28 | 1 < 4 | 3.84 |

| Audit sample ANOVA summary Ho: No differences among laboratories' reported values | | | | Routine data within-sampling--class standard deviation | Maximum laboratory value difference, divided by routine data standard deviation |
|---|---|---|---|---|---|
| Horizon | Error DF | Standard deviation | Significance level | | |
| Oa | 3 | . | . | . | . |
| A | 6 | 118.378 | 0.632 | 19.118 | 2.21 |
| Bs | 11 | 7.145 | 0.027 | 17.081 | 1.38 |
| Bw | 9 | 7.351 | 0.410 | 12.412 | 0.77 |
| C | 11 | 1.737 | 0.010 | 8.836 | 0.43 |

Figure A.57. Interlaboratory difference analysis of specific surface.